FLIGHT
and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

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Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

8-10, CORPORATION ST., COVENTRY. *Telegrams:* Autocar Coventry. *Telephone:* Coventry 5210.

GUILDHALL BUILDINGS, NAVIGATION ST., BIRMINGHAM, 2. *Telegrams:* Autopress, Birmingham. *Telephone:* Midland 2971 (5 lines).

260, DEANSGATE, MANCHESTER, 3. *Telegrams:* Iliffe, Manchester, *Telephone:* Blackfriars 4412.

26B, RENFIELD ST., GLASGOW, C.2. *Telegrams:* Iliffe, Glasgow. *Telephone:* Central 4857.

SUBSCRIPTION RATES: Home and Abroad: Year, £2 8 0. 6 months, £1 4 0. 3 months, 12s. 0d.

Registered at the G.P.O. as a Newspaper.

No. 1656. Vol. XXXVIII. SEPTEMBER 19, 1940 Thursdays, Price 9d.

The Outlook

A Confession of Failure?

UP to Saturday, September 7, the object of the *Luftwaffe* was clear. That force was trying its hardest to paralyse the R.A.F. Fighter Command by attacks on its aerodromes and on the factories which make fighter aeroplanes, while at the same time trying to over-work the fighter pilots. Evidently the High Command realised that until the Fighter Command was rendered ineffective it was impossible to do anything towards putting the Bomber and Coastal Commands out of action. The prospects of invading Great Britain, thin as they must be at any time, call for a measure of surprise and also for a comparatively quiet period in which to complete the preparations at the ports on the Continent. While the machines of the Coastal Command spied out pretty well everything, surprise was out of the question; so long as the Bomber Command continued to wreck the barges, a start was problematical; and if, supposing the sea had been crossed and the place selected for disembarkation reached, British bombers could rain bombs on the landing troops, the chances of the Germans establishing themselves on shore were very remote. Therefore, everything hinged on the destruction of the powers of the Fighter Command.

The attacks of the *Luftwaffe* on the aerodromes and factories met with very little success. Well-organised aerodromes can continue to function even after a good deal of bombing. The mass daylight raids cost the enemy dear in machines and crews. The German High Command never refuses to face heavy casualties if only its object can be obtained, but obviously in this case the result did not justify the losses. Daylight bombing, the Germans hold, is the only form of air attack which gives satisfactory results, but daylight bombing also gave too good a chance to British fighters to defeat the objects of the raids. There seemed no profit in continuing those tactics, but what was to be done?

The New German Tactics

ACCORDINGLY, so we read the situation, on the night of Saturday, September 7, the previous tactics were abandoned, at least for a time, and all energies were turned over to night-bombing of London. The Germans themselves do not expect military results from night-bombing, and the chances of crippling Britain's war effort to any useful extent by a lucky shot in the dark were remote. Even when weather conditions on the morning of Friday, September 13, permitted a prolonged raid by daylight, the German bombers continued to concentrate on London, and the deliberate attack that day on Buckingham Palace showed that "frightfulness" rather than military considerations was animating the *Luftwaffe*.

These raids on London have been full of private tragedies, and they have done some damage to public buildings which the whole civilised world deplores. St. Paul's Cathedral was only saved from demolition by the heroism of a party of sappers. There has been considerable inconvenience caused to nearly all sections of the population, from the King and Queen downwards. But nothing has been achieved which will prevent the British Empire from winning this war. Did the German High Command hope for any more concrete result? We cannot believe that it did. The only plausible explanation of this sudden concentration of effort on blind attacks on the Capital is that the Germans had realised the failure of their previous tactics, and wished to avoid the admission of failure by starting on some other spectacular exploit which would please their people.

The Effects of Weather

DURING the first four days and nights of the London raids the weather was mainly clear. There were clouds in places on the first two nights but no solid bank. Experience through many years of air exer-

cises had taught that clear skies ought to favour the defence. Air defence at all times depends in the first place on the Observer Corps, and in this war it has not failed. No blame can be fixed there. By night air defence (that is to say, destruction of the raiders) depends entirely on efficient work by the searchlights and their sound-locators. If the beams can catch and hold a raider, it ought to be straightforward work for either fighters or guns to bring that raider down. But now we British are paying a heavy price for years of bad organisation and neglect. *Flight* is not reflecting in the slightest degree on the searchlight crews. Many times during the inter-war years we have heard their officers and men bewailing the fact that their equipment was out of date. The fact is that the searchlights and their men are under the War Office, not under the Air Ministry, and for years past the War Office scandalously disregarded and starved that most important branch of our defences.

The theories about weather and air defence which we mentioned above were proved sound on the morning of Friday, September 13, when masses of broken cloud with numerous gaps hung over London. The German bombers took advantage of these conditions, and spent four hours and more over the Capital. Evidently they did not need to rely on escorts of fighters, for there were always clouds in which they could take cover, and they were under no necessity to turn homewards when the fuel supplies of Messerschmitt 109s were running low.

To meet the night raiders we have changed our tactics, exposing few searchlight beams but putting up heavy gunfire. That has had the result of disconcerting the German crews, and they have nearly always changed course when they met the barrage of shells. Some of the raiders have been brought down, and the spirits of the population have been greatly cheered by the audible proof of an active defence and by its results.

There is now ample evidence before the British High Command, and we hope they will not be so blind as to misread the lesson. The only sound principle for organising air defence is to put every element of it under the Air Ministry.

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SUNDAY, September 15, will live in the annals of the Royal Air Force. For over a week the pilots of the Fighter Command had been eating their hearts out because they had been able to do nothing to stop the brutal night bombing of London. Many of them are London men, and it must have been a terrible experience to them to know that their families were in danger, night after night, and they were sitting helplessly on their stations. Friday morning, September 13, cannot have eased their feelings, for the clouds gave the German bombers all the advantage over the defence.

But on Sunday the German machines came in strength and by daylight. From the beginning of the war British fighter pilots have always fought magnificently, but on that Sunday we feel sure that they put more into their efforts than they had ever put before. It was vengeance on a cruel and vile foe, an enemy of all that is decent in humanity. Out of not more than 400 German machines which crossed the coast at least 185 paid the penalty and will never bomb Britain again. That is not very far short of 50 per cent. of the raiders, and means the loss to the *Luftwaffe* of quite 460 airmen. The cost of this tremendous victory was 25 British machines, from which at least twelve of the pilots escaped in safety. Seldom, if ever, has so great a success been won at so small a cost.

MR. KENNEDY'S OTHER FAMILY: (L to R, Back Row): Major G. Bryan Conrad, Field Artillery Asst. Military Attache; Major George C. McDonald, Air Corps Asst. Military Attache; Major Rene R. Studler, Ordnance Dept. Asst. Military Attache; Lt. D. J. MacDonald, U.S.N. Flag Lt.; Lt. C. G. Campbell, U.S.N.R.; and Ensign W. S. Mailliard, U.S.N.R. (L to R, Centre): Major S. A. Greenwell, Cavalry Asst. Military Attache; Lt. Col. Charles E. Loucks, Chemical Warfare Service, Asst. Military Attache; Lt. Col. Frank O'D. Hunter, Air Corps Asst. Military Attache; Col. Carl Spaatz, Air Corps Asst. Military Attache; Cdr. Vaughan Bailey (Ret.), U.S.N. Asst. Naval Attache; Lt. Cdr. W. B. Ammon, U.S.N. Asst. Naval Attache; Lt. Cdr. B. L. Austin, U.S.N. Flag Secretary; and Lt. Francis X. Forest, U.S.N. Asst. Naval Attache. (L to R, Front); Col. Martin F. Scanlon, Air Corps Asst. Military Attache; Col. Raymond E. Lee, Field Artillery Military Attache; Brig. General Strong, Asst. Chief of Staff one of the Observers; Major General Delos C. Emmons, Commanding G.H.Q. Air Force, Army Air Corps, one of the Observers; H.E. The American Ambassador, Joseph Kennedy; Rear Admiral Robert L. Ghormley, U.S.N. one of the Observers; Capt. Alan G. Kirk, U.S.N. Naval Attache; Cdr. L. C. Stevens, U.S.N. Asst. Naval Attache; and Cdr. N. R. Hitchcock, U.S.N. Asst. Naval Attache.

WAR in the AIR

Dogfight Doodle : The trails left in the sky after an air fight.

The Battle of London : Buckingham Palace Bombed : Fighters' Great Victory

THE Prime Minister, Mr. Winston Churchill, made a solemn broadcast to the nation on Wednesday, Sept. 11. The air side of the war occupied most of his discourse, and he also spoke very seriously about the chances of an invasion before long. The following are extracts from his speech:—

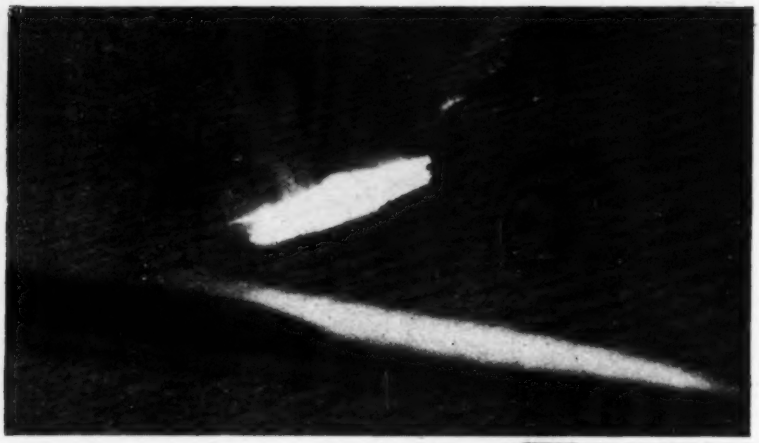
"This effort of the Germans to secure daylight mastery of the air over England is, of course, the crux of the whole war. So far it has failed conspicuously. It has cost them very dear, and we have felt stronger, and are actually and relatively a good deal stronger, than when the hard fighting began in July. There is no doubt Herr Hitler is using up his fighter force at a very high rate, and that if he goes on for many more weeks he will wear down and ruin this vital part of his Air Force. That will give us a great advantage. On the other hand, for him to try to invade this country without having secured mastery in the air would be a very hazardous undertaking." Mr. Churchill went on to describe the German preparations, and continued:—"Every man and woman will therefore prepare himself to do his duty, whatever it may be, with special pride and care. Our Fleets and flotillas are very powerful and numerous. Our Air Force is at the highest strength it has ever reached, and it is conscious of its proved superiority—not indeed in numbers, but in men and machines. Our shores are well fortified and strongly manned, and behind them, ready to attack the invaders, we have a far larger and better equipped mobile army than we have ever had before. Besides this, we have more than 1,500,000 men of the Home Guard, who are just as much soldiers of the Regular Army in status as the Grenadier Guards, and who are determined to fight for every inch of the ground in every village and in every street. It is with devout but sure confidence that I say 'Let God defend the right.'

"These cruel, wanton, indiscriminate bombings of London are, of course, a part of Hitler's invasion plan. He hopes, by killing large numbers of civilians, and women and children, that he will terrorize and cow the people of this mighty Imperial city, and make them a burden and anxiety for the Government, and thus distract our attention unduly from the ferocious onslaught he is preparing. Little does he know the spirit of the British nation, or the tough fibre of the Londoners, whose forebears played a leading part in the establishment of Parliamentary institutions and who have been bred to value freedom far above their lives. . . .

"This is the time for everyone to stand together and hold firm, as they are doing. I express my admiration for the exemplary manner in which all the air-raid precaution services in London are being discharged, especially the fire brigades, whose work has been so heavy and also dangerous.

"All the world that is still free marvels at the composure and fortitude with which the citizens of London are facing and surmounting the great ordeal to which they are subjected, the end of which, or the severity of which, cannot yet be foreseen. It is a message of good cheer to our fighting forces on the seas, in the air, and in our waiting armies in all their posts and stations, that we send them from this Capital City. They know that they have behind them a people who will not flinch or weary of the struggle, hard and protracted though it will be, but that we shall rather draw from the heart of suffering itself the means of inspiration and survival, and of a victory, won not only for ourselves, but for all—a victory won not only for our own times, but for the long and better days that are to come."

Saturday, Sept. 7, as stated in our last issue, saw a supreme effort to subdue the R.A.F. and prepare the way for the possible invasion. Combined with this was the beginning of a series of heavy attacks on London, which the Germans declared to be reprisals for our bombing of military targets in the Berlin area. The day opened with-



WAR IN THE AIR (CONTINUED)

(Left) Direct Hit : A Short Sunderland bombs an Italian submarine which has crash dived.

(Below) Painless Extraction : Troops removing ammunition belts from a captured Me. 109. The German fighters carry rather more rounds per gun than do our machines but we have a greater number of guns.

out any strenuous activity in the air. Then, shortly after 4 p.m., large waves of bombers escorted by fighters began to cross the South-East coast. The first wave was about 150 strong, and the second comprised some 200 machines. They spread out, some making for aerodromes while others went for the docks in the Thames. Our fighters attacked them with fury, and smote them with great success, shooting down 75. The A.A. guns accounted for another 28, making a total of 103 for the day. Of our machines 22 went down, but 14 of the pilots escaped by parachute. The raiders lit large fires in the dock area.

That night saw the first of a series of cruel raids in the darkness over London. Guided by the fires in the dockland area, some 70 heavy bombers flew to and fro over the capital during the night, while another 30 waited over the coast and Channel. At first they dropped more bombs on the dock area, then roughly up and down the banks of the Thames, and as the night went on they ended by visiting nearly all the districts of the London area and dropping bombs broadcast. The searchlights were very active, but for the most part the Germans kept high above the range of the beams. Very little gunfire was heard, and though fighters went up they were unable to intercept the unseen raiders. Much damage was done, something over 300 people were killed, and about 1,340 were injured. The homes of very many more were destroyed, mostly the humble homes of poor people living in the crowded districts of the East End. The fire brigades and all the A.R.P. services did splendid work.

A Lurid Scene

THE nights of *Sunday, September* 8 and *Monday, 9th,* were practically repetitions of the Saturday. The raiding started soon after dark and went on until just before dawn, nine hours or thereabouts. Londoners began to get into the routine of the business, and made arrangements for sleeping in comparative comfort in the shelters. On the Sunday night there were some low clouds hanging overhead, and they reflected the glow of the fires and spread it over the whole sky. Cones of searchlight beams framed the lurid scene, while every now and then one heard the sound of the A.A. guns and the occasional "crump" of falling bombs.

Each night there was much damage done, and many tragedies were recorded. One delay-action bomb fell just outside the northern wall of Buckingham Palace, and when it exploded some hours later it did considerable damage. The King and Queen were not in residence at the time, and there were no casualties. But several hospitals were hit and both patients and nurses were killed and wounded. Several museums also suffered, but not very badly, and the most valuable of the treasures had been removed long before to places of safety. More than one church was also bombed. All districts and all classes suffered, but inevitably the crowded districts in which the poor live came off worst. The courage and cheerfulness with which they bore their misfortunes aroused the most intense admiration, especially among American press correspondents, who informed their papers that the British spirit was unbeatable. The King and Queen, whose own home and personal belongings had been damaged, went around the districts which had suffered most heavily, condoling with the homeless and the bereaved, and everywhere bringing comfort and renewing courage. The Prime Minister made similar tours.

After the German loss of 103 machines in the daylight raid of Saturday, the Germans seemed a bit out of heart about raids by day. On the next day, *Sunday, September* 8, very few raiders came over, and the R.A.F. were only able to shoot down five, the A.A. guns for once going one better with six. On *Monday, September* 9, there was a resumption of day raiding, and in the evening between 5 and 6 p.m. 350 enemy aircraft crossed the Kent and Sussex coasts. That gave our fighters and A.A. guns another chance, and between them they shot down 52, three of them falling to the guns. We lost six pilots and a total of 13 fighter machines. *Tuesday, September* 10, was another fairly quiet day, so long as it was day, and

WAR IN THE AIR (CONTINUED)

only two enemy machines were brought down. There was another busy day on *Wednesday, September* 11, when some 275 enemy machines crossed the coast, mostly heading towards London, though one formation made for Southampton. Again our fighters, including the Polish squadron, scored a great victory, and the enemy's losses for the day amounted to 89 machines. We lost 14 pilots and a total of 17 fighter machines.

Changed Defence Tactics

THAT night a complete change was made in the defence tactics of London. Searchlights only showed occasionally, but everywhere the German raiders were met with a very heavy concentration of anti-aircraft fire. The din was loud, and went on spasmodically all through the night. It was evident that the German air crews did not relish this sudden change of affairs. No longer were they able to cruise about at their own sweet will, committing murder and spreading havoc without restraint and in perfect safety themselves. On all sides it was noticed that when the barrage broke forth, the sound of the German engines died away, as the pilots turned off their course to escape the hail of bursting shells. Bombs were dropped, of course, sometimes, it seemed, to lighten the bomber, but also in all probability to give the crew a good excuse for making off home. On the whole, the damage done in London was somewhat less than on the four previous nights. Most certainly the sound of the guns had a heartening effect on the people in their shelters. They had proved that they could endure, but they liked to hear British guns striking back at the night murderers.

This new form of defence seemed to have a discouraging effect, and on the night of *Thursday, Sept.* 12, the raiders were far less numerous, and less destructive. The first came over at 9.15 p.m., and was promptly met with the same concentrated fire from the A.A. guns. Each district of the London area had periods of quiet, sometimes lasting for half an hour or more, during which no engines could be heard overhead.

The morning of *Friday, Sept.* 13, broke wet and dismal, with masses of low cloud and intermittent rain. The Germans apparently greeted these conditions as being more favourable for bombing than a clear night. During the fine spell their bombers had always been escorted by large numbers of fighters, and if the latter were of the Me 109 type, their tankage limited the duration of the raid to an hour or an hour and a half. With clouds to give them cover, the German bombers saw more chance of eluding the British fighters, and during the morning indulged in a long raid which lasted from 9.45 a.m. to 1.55 p.m. There were frequent breaks in the cloud banks, and through these they dropped their bombs. One pilot dived through a gap and planted five bombs on or near Buckingham Palace.

The Fighters' Glorious Day

WE must hurry on to the notable day of *Sunday, Sept.* 15. Two heavy raids were launched in the daytime, one at about noon and the other about 2.15 p.m. Each lasted for the usual time of slightly over an hour. In the midday raid Buckingham Palace was bombed for the third time, but the damage was not serious and nobody there was hurt. Their Majesties were not in residence at the time. The fighter pilots, naturally savage at the cruelty done to their homeland, and hipped at not having been able to do anything much during the night raids, asked for nothing better than to see masses of enemy machines before them in daylight. They fell on them with the cool fury which is more dangerous than any Hitlerian hysterics. Never before have our fighters taken such fell toll of raiders. During the day at least 187 German machines were shot down, and some of them fell in London streets, to the great delight of the onlookers. We lost 25 machines, but at least twelve of the pilots survived. Göring's air mastery of Britain receded still further into the distance.

A Good Specimen : An Me. 109 shot down in the south-east. The two synchronised guns lying on top of the engine can be clearly seen and the wing tip slots are also apparent. The conical box in the foreground is an ammunition container.

WAR IN THE AIR (CONTINUED)

AIR LOSSES DURING WEEK ENDING SEPT. 14

	German			British	
	By R.A.F.	By A.A.	Total	Aircraft	Pilots
Sept. 8 ...	5	6	11	3	2
" 9 ...	49	3	52	13	7
" 10 ...	2	—	2	0	0
" 11 ...	80	9	89	24	17
" 12 ...	1	2	3	—	—
" 13 ...	1	1*	2	—	—
" 14 ...	16	2	18	9	3
Totals ...	154	23	177	49	29

* By Barrage Balloon.

One of the British bombers which raided Berlin on the night of Wednesday, Sept. 11, had an adventurous time on the way back. It had been damaged when diving through heavy *Flak* fire and ran out of petrol in the North Sea. The four members of the crew took to the rubber dinghy, and were adrift for 12 hours before they were picked up off the South Scottish coast.

They were located by a flying-boat which guided the launch to them, and indicated the position of the dinghy by repeatedly diving towards it. The sea was so rough that before the flying-boat arrived the launch had passed within 50 yards of the dinghy without observing it. All the survivors were unhurt, and, although exhausted, gave an account of the Berlin raid after coming ashore. The Captain reported that he saw a fire in the surburb of Berlin when he was 60 miles away from the city. "This turned out to be the gas works which was my target," he said.

In the meantime our reconnaissance machines had spotted large numbers of self-propelling barges and other ominous-looking craft in the harbours of the coast, and the Bomber and Coastal Commands launched continuous attacks on them. It really looked as if the preparations for the threatened invasion were almost ready, but the R.A.F. determined to put as many spokes as possible into the wheel.

Holding Off the Invasion

WHILE Berlin was being raided on Tuesday night, *September* 10, other sections of R.A.F. bombers attacked the docks at Bremen and the naval yard at Wilhelmshaven. Several hits on the docks were made in spite of bad weather and one bomb-aimer saw four small fires and several explosions follow one of his salvos. Another target was the Bremen Focke-Wulf aircraft factory. Three buildings were on fire after the attack. At Wilhelmshaven weather conditions were rather better. In an early morning attack one of the heavy bombers was especially successful. The pilot began to bomb a few minutes after three a.m. In just over a quarter of an hour his bomb-aimer had landed a heavy bomb on the naval barracks, just south of Bauhafen, and another on a large building west of Bauhafen which at once burst into flames. Other bombs fell on the docks, but their effect could not be seen. This raider had to cope with violent opposition from the defences. The aerodromes at Wesermunde and Barge where there were several explosions and the Duisberg railway centre were also bombed. The night's operations included attacks on military objectives in Belgium.

The captain of the R.A.F. aircraft which raided Calais on the same night said "We had no difficulty in picking up Calais and its port, which showed clearly in the bright moonlight and the light from a string of ground fires. We made our run from a fairly low height and dropped bombs in a short stick along the east side of the Carnot Basin. There were many barges packed on this side of the Basin, and our bombs burst among them. Masses of debris flew into the air. When we left we saw fires started by our incendiaries and observed a number of explosions. When we made our attack the ground defences opened up in earnest, and as we climbed higher we were pursued by a storm of tracer and heavy shells. My rear gunner shot them 'au revoir' with a burst of machine-gun fire and one or two of the anti-aircraft crews ceased fire immediately."

These sort of raids by our bombers went on every day and night. On the night of *Friday-Saturday, September* 13-14, Antwerp was the most important target, though there were British raids all along the coast. A Flight Lieutenant, describing his part in the raid on Antwerp, said:—

"As we approached the Dutch coast a Messerschmitt 110 came up. It was about 500 yards on our port side. I think it was just spotting our height and course, because it never came in to attack. It circled the aircraft once and then turned off. We picked up the river about 10 miles from Antwerp. Fires were already burning in the dock areas when we arrived. It was so clear it was almost like day. It was the perfect target. Even from 6,000ft. I could see perfectly. I could make out streets and houses in the town. We dropped our first stick of bombs from 6,000ft. They straddled the dock. I decided I would make a low-level attack to drop the second stick. We circled over the town, went away about five miles, and then came down with a steep dive. Just as we were approaching the dock we ran into a very intense barrage of anti-aircraft fire. The port main plane was hit, and I could feel a sort of kick on the stick. The wireless operator came along and said that this wing was on fire. He told me it was lighting up the whole of the interior of the aircraft where he was. I looked out and saw the fire. We were then dead over the target. We carried on, then dropped a stick of 10 heavy bombs. The first six went across the docks where these barges were.

"I could make out a brick building with a large chimney which might have been a warehouse or a power station. Our last three bombs straddled the end of this target, and there was the most colossal explosion. It really was terrific. As I turned the aircraft I could see bits of the target flying up into the air. As soon as we had bombed I pulled up the nose and began to get back some height. The fire in the wing had gone out; it only lasted about three minutes or so. We found out afterwards that there was about four square feet of fabric burnt off. We came back as fast as we could. The port engine started to cut owing to the main petrol pipe in the port wing having been damaged. We drew petrol from the starboard tanks, and it picked up again. We could see the fires in Antwerp docks from 30 miles away."

A Novel Incendiary

THE Royal Air Force are using a form of incendiary weapon which could be described as a self-igniting leaf. It is designed to set fire, for example, to military stores standing in the open at an arsenal or ammunition factory, to a dump of engineer's stores in the field, to military supplies in an open railway truck in a marshalling yard, to a park of military lorries and other similar objectives. It would also set light, under suitable conditions, to a wood in which a military unit, a depot or ammunition plant has been concealed. It is known that the enemy has concealed such targets in woods. The accusations made by the Germans that the "leaves" cause poisoning is false. The "leaf" is not poisonous, but if handled it would, of course, cause burns just as every other incendiary bomb would do.

A Norwegian motor torpedo-boat, co-operating with British naval forces, has shot down a German aircraft into the sea. The Norwegian motor torpedo-boat was in the vicinity of a merchant vessel when both were attacked by enemy dive-bombers. They were at once engaged and the formation broken. It was then observed that aircraft which had unsuccessfully attacked the merchant ship were passing overhead. They were at once engaged and several hits with tracer bullets were seen. One of the aircraft then side-slipped badly and was seen to be on fire. It succeeded in flattening out, but continued to lose height. It touched the water once, rose a few feet, and then crashed into the sea.

AIR EXPANSION IN CANADA

Acceleration When a Stop Seemed Imminent : Red Tape Cut Through : Canadian Air Minister's Statement

THE salient features of Canada's air effort were referred to by the Hon. C. G. Power, Minister of National Defence for Air, in a speech in the Canadian House of Commons recently.

The Canadian effort has two sides to it—military operations, and the British Commonwealth Air Training Plan.

In operations, Canada has had many men serving overseas with the R.A.F. since the start of the war; and since then squadrons of the R.C.A.F. have been despatched to the United Kingdom and later reinforced.

Also on operational work are the squadrons comprising the home war establishment, defending Canada's coasts, doing reconnaissance and patrol work and affording protection to convoys. The home war establishment is also busy now setting up stations and aerodromes at strategic points throughout the country.

The British Commonwealth Air Training Plan is regarded now as of even greater importance than before the *Blitzkrieg* started. Its long view is not being altered, but to meet immediate demands its schedule is being accelerated. To-day there are 22 schools in operation, whereas the original plan called for only 15 at this date.

Eight elementary flying training schools are operating in place of two, and two initial training schools instead of one.

Besides the various types of training schools for pupils there are now established 20 recruiting centres, three manning depots, three equipment depots and one repair depot.

Plans have been completed to finish construction this year of all aerodromes, hangars and other buildings for all schools scheduled to open in 1941, whereas much of this work was to have been done next year.

By July 1 last, 78 of the 88 aerodrome sites required had been considered and approved, and work was progressing on 63. To-day an additional four sites have been approved, and work is progressing on 78. Construction work has been speeded up to make these advances possible, contractors of all kinds working two and three shifts daily, seven days a week, and employing as many men as possible. Industrial leaders and labour itself were praised for their part in this work.

There has been an accompanying acceleration in the growth of personnel for the Plan. In two months officers trained and in training for the administration of the Plan have increased from 1,001 to 1,216; other ranks, 6,306 to 10,524; civilians, 1,539 to 2,208; and pupils in training as pilots, air observers and air gunners, from 488 to 2,643.

The growth in strength of the R.C.A.F. is shown by the following table:

	Officers	*Airmen*	*Total*	*Civilians*
March 31 ..	1,223	9,187	10,410	1,029
April 30 ..	1,307	10,824	12,131	1,362
May 31 ..	1,418	12,331	13,749	1,911
June 30 ..	1,631	15,870	17,501	2,407
July 24 ..	1,765	17,688	19,453	2,558

There has been no difficulty in procuring recruits despite the fact that before the first actual pupils of the B.C.A.T.P. could be trained there had to be recruited, trained and organised an immense staff to operate the Plan itself; all

Tiger Moth fuselages nearing completion at the De Havilland Toronto factory. Note the special coupé top for winter flying.

the way from high administrative officials through technical instructors down to floor sweepers.

With respect to aircraft supply, there is no shortage of aircraft for elementary training. In fact, orders and deliveries for these are proceeding in advance of schedule. Aircraft for advanced training have have been held up by Britain's unavoidable postponement of delivery of her intended contribution of these planes as part of her share of the B.C.A.T.P. Consequeatly, the Canadian government has had to act in three ways:—

(a) To prepare for the production of Anson airframes in Canada and to procure suitable engines for these from the United States.

(b) To procure in Canada a new type of single engine advanced training aircraft designed to take an American engine and capable of quantity production at short notice. These may usefully be employed in continuation of the U.S. supply of engines.

(c) The gap caused by these delays has been bridged by purchase of existing aircraft in the United States and by the taking over of a substantial number of trainers of the Harvard type originally intended for France.

Further as to aircraft supply the Minister said: "The best news of all is that we have just recently been advised by the United Kingdom that it is prepared almost at once to resume shipments to us of the particular kinds of training aircraft of which we stand most in need." When some months ago there was a lessening of aircraft supply, the Canadian government refused to reduce its plans to such a reversal, but rather pushed ahead its expansion of construction and personnel in anticipation of the full resumption of aircraft supply. The Minister felt that that policy had proved manifestly sound.

Major Power lauded the indispensable aid received from the Minister of Munitions and Supply and his department in dealing with the problem of aircraft supply. "The relatively satisfactory situation I am able to describe to-day is due in large measure to his efforts."

The Minister also paused in his speech to remind the House that while now there were Ministers at the head of the three Services this work and heavy responsibility now divided among three was not so long ago carried by one man—the late Norman Rogers.

The Minister estimated that during the fiscal year ending March, 1941, Canada will spend on home war establishment $10,700,000 more than the $86,624,403 announced last month. Overseas participation cost remains as earlier estimated, $13,382,598. To the original estimate of $138,417,264 for the B.C.A.T.P. has been added $54,000,000, of which $42,000,000 is to be paid by the U.K.

The Minister's speech concluded with this summary of the Air Training Plan:

"Though only in its very beginnings, it has already had its trials and tribulations, its vicissitudes and dark days. There were those of us who in our impatience and, perhaps, despair, were ready to scrap it altogether. It was and is difficult of comprehension to an eager and impatient people.

"But there is to-day a better and a clearer understanding. After all, a little reflection and a sense of comparative value will bring one to this conclusion, one which so far as I know has not as yet been publicly expressed.

"If it takes, as it did in the last war and again in this one, at least six months to train an infantryman, the least technical of all soldiers, why should it not take 28 weeks to train an air pilot, who handles alone one of the most complicated pieces of mechanism known to humanity!

"There is, I know, a sentiment in the public that the Plan is liable to be strangled or impeded by what is known as brass-hatism. I can only say this. That as a Canadian, with, I hope, the civilian trend of thought, I have found the regular permanent officers of the Force not only fully alive to the importance of the Plan, but thoroughly imbued with the determination to make it go. Associated with these permanent men are other high officers either from the reserve or taken directly from civilian life, who, six or eight months ago, were leading engineers, architects, business men, commercial aviators and business administrators. If any red tape ever existed, it disappeared long before my time, and they have been too busy ever since to wind up any new rolls.

"The Plan is proceeding, the work is progressing. When it seemed bound to slow down and perhaps be halted, we accelerated it. To-day, we are not yet out of the woods, far from it, but we believe we can see a picture, not finished, not complete, but somewhat less grey and nebulous than it was. We have had our share of disappointments. Mistakes and blunders we make and commit every day. We endeavour to repair the one and to remedy the other. We need help, tell us of what is lacking, point out what is wrong. If possible, tell us how to repair the falling fences, show us where the drawbacks are.

"Those of us who are closely associated with it firmly and steadfastly believe the Plan will win through. We have been told that it is Canada's most important contribution to the common effort, and the common victory. We are determined that it shall be."

Assembling Tiger Moth fuselages in the De Havilland Toronto factory which has been considerably extended.

Air Strategy—XX

AIR BLOCKADE—X

Psychology of Overrun Nations is an Important Factor in Air Blockade

By CAPT. NORMAN MACMILLAN, M.C., A.F.C.

THOSE responsible in the United Kingdom for the planning of Britain's air blockade (it is noticeable that since I began to write this series of articles the term "air blockade" has come into wider use) must consider the psychological as well as the material aspect of air attack in relation to some of the areas which I have placed in Zone 4, which comprises the area east of the line Stettin, Berlin, Leipzig, Nüremberg, Ulm, Friedrichshafen, and certain other areas which were defined in *Flight* on August 22.

The problem before the German leaders is a different one. They have at the moment but one target, the United Kingdom. Their partner, Italy, can hold the British forces in and about the Mediterranean for the time being. That is the reason why Italy was asked to enter the war at the moment she came in, on June 10. At that date it must have been already clear to the German High Command that France would soon collapse, and it was therefore necessary to get the Italian forces deployed. For two reasons: To hold the French forces in Africa while Germany finished off the French forces in France; and to serve as a row of pawns to screen the German forces in Western Europe from the British forces in the Mediterranean and the Middle East.

The One-front Doctrine

The entry of Italy into the war at midnight on June 10-11 preserved the Hitlerian doctrine of the war on one front only at one time. Italian strategy was bent by the Prussian will to permit the German forces to be reorganised safely to fight against the British Isles as soon as possible after France was suitably disposed of.

It may well be that another objective was attained by the entry of Italy into the war at the precise moment she came in. That was the primary solution of the Balkan problem without recourse to arms.

Italy's entry certainly assisted in confining the Balkan triangle formed by Roumania, Hungary and Bulgaria, for Italy acted as a counter to both the passively hungry bear, Russia, and the actively angry lion, Britain. Italy was strategically well disposed in the Mediterranean by her possession of Rhodes and the Dodecanese Islands, and her ability to put pressure upon Greece through the contiguity of Albania. Roumania was isolated while the surgical knives were got ready for the inevitable operation. Thus once more Hitler solved the problem of the single front at one time by the avoidance of hostilities in the Near East. And he did more. By his enlargement of Hungarian and Bulgarian territories he gained two strengthened adherents to his side, while the resulting unrest in Roumania created the condition essential to the seizure of power by the Fascist Iron Guard.

One other thing the Axis move has done is to provide a stronger buffer between themselves and Russia for as long as they wish themselves to be absolved from shocks, yet at the same time they have secured a possible corridor for operating against Russia should the necessity arise. The need for this buffer corridor against the Southern Ukraine was made more urgent because in the north the frontier of Russia abuts on the new greater Greater Germany in East Prussia, Poland and Ruthenia. But the Italo-German "solution" to the Balkan problem has not solved the troubles of Eastern and South-Eastern Europe; that *fait accompli* has merely presented the world with a new equation in place of the former equation.

In the meantime Magyar-Bulgar pincers have been put about the heart of Roumania, as Austro-German pincers were put about the heart of Czechoslovakia in 1938. The territorial configuration in each case is uncannily and uncompromisingly alike; the capital is enfolded from the north and south. Roumania must bow to the dictates of the Axis; Stalin has been checkmated and the one-front policy can be maintained by Germany against the United Kingdom and by Italy in and about what Germany calls the Middle Sea, Italy calls Mare Nostrum, and we call the Mediterranean.

The British Empire, fighting alone, has been outmanœuvred on to a double front, and for the present we are fighting defensively on both. Yet, by virtue of these two fronts it is possible for the British Empire to maintain a blockade of all the sea approaches to Europe and to render even trans-Mediterranean sea communications a somewhat perilous process.

The operations in and about the Mediterranean and the Red Sea deserve a much closer examination, and I propose to deal with them later in this series of articles. To regard them in detail now encroaches too much on the present aspect of the war which we are considering. Let it suffice to say that, strategically, we are sparring to keep Italy off, for only the first round of the war of the second front has been fought. And the war there, as in Western Europe, is a war of staying power between heavyweights.

As I write, Hitler is trying to land a knock-out punch against the British Isles with his air force. It is immaterial whether that blow comes from the right or whether it is a lead from the left in preparation for a punch from the right with his ground forces. It is the effect of the blow which counts.

No Queensberry Rules

How is that blow to be regarded? Is it a legitimate attack in the military sense? Or is it a foul blow directed against unarmed civilians? The answer is that there is a lot of illogical thinking about this aspect of modern war, but the truth is simple and clear. It is just this: There are no longer any rules of war. The days of chivalry are dead on the continent of Europe. One need only look at the photographs of the faces of Hitler and Mussolini to see that they are no gentle knights.

We are back to the days of the sacking and burning of cities, of the boiling pitch and oil methods of war brought up to date. Already 116,000,000 people in Europe know that no quarter is given by the protagonists of the new kind of warfare; and that does not include the 54,000,000 inhabitants of Danzig, Estonia, Latvia, Lithuania, Roumania, Austria and Spain, whose fate has been decided in a somewhat different way, by the threat or partial practice of totalitarian war.

AIR BLOCKADE (CONTINUED)

The people of the British Isles have only one advantage over the peoples of the mainland, the advantage of living on an island, the one credit we can place against the terrible debit built up through the purblindness of the nation and its leaders five, six, aye, seven years ago. It is that fortunate geographical circumstance which can enable Britain to defeat the power arrayed against her, but in the process the heads of her people will be bloody if unbowed.

Yet this terrible tribulation can be turned to good account in the process of air blockade which Britain is applying to the German and Italian territories.

If we were immune from air attack here in Britain and we were carrying out devastating attacks against territory now held by Germany in parts of Europe not formerly German, the local inhabitants who are not of German birth might begin to blame Britain for their miseries and lean more towards their present masters for protection. This aspect of the effect of Britain's air blockade would be turned to account by the Germans if they got the slightest opportunity to do so. But those who listen to any of the German broadcasts at the present time must hear the new inflexion in the voices of the announcers. In spite of their poor English and their frequent mispronouncing of our English language, their gloating over the air bombardment of London has been unmistakable.

The German attitude cannot be misunderstood by the peoples of the already overrun (I will not say conquered) lands. They must realise, from the unrestrained description of the bombardment, that Britain is fighting for her life, and that the people of the great cities of the United Kingdom are suffering what they have already suffered. And they must think of that sea which surrounds Britain and pray that we shall hold out until we overthrow the power of Germany and Italy.

Special Broadcasts

To those peoples we should radiate a special type of broadcast. For there is in Europe, in the overrun lands, a potential fifth column for the British side, whose numbers are as great as are the numbers of the complete populations of true Germany and Italy combined. That fifth column must be taken into account in every process of the application of our air blockade. And to that air blockade there should be a radio accompaniment.

These two, radio and bombs, ought to work hand in hand, as the German broadcasts devised by the German Propaganda Ministry are endeavouring to work in collaboration with the attacks of the *Luftwaffe*. Properly carried out, the British broadcasts could beat the Nazis. For the Nazi broadcasts, principally designed for consumption in still unconquered lands, have for their object the spreading of terror or at least apprehension where the bomb of the Nazi has not yet fallen. Whereas British technique would concern the opposite side of the picture, and have the objective of fostering a spirit of brotherliness in times of tribulation, and of keeping alive in the overrun lands the knowledge of the undaunted character of the Anglo-Saxon-Celtic race. For one day we shall want them to arise and aid us to overpower the hordes that have overrun their lands. And to attain that end we should not bomb objectives in their territory without an accompanying explanation. If they know that they can find an explanation of the general British plan upon the British radio, they will be able to follow what is happening, even in their own countries, and will be the more prepared, when the moment comes, for the rising to resurrect their liberties.

The necessity for a combined air blockade and radio campaign applies mainly in the most easterly territories now held by Germany, namely, Czechoslovakia and Poland, but it should be carried out everywhere, in the broadcasts to Norway, France, Belgium, Holland and Denmark. Mere radiation of news bulletins is not enough. The nature of the strategy behind the British raids upon enemy-occupied territory ought to be explained in such a way that it is intelligible to the poorest peasant. That could be done without endangering in any way the conduct of the actual operations. Particular localities should be referred to in these broadcasts in such a way as to make it clear that the localities were well known to us here and that we were familiar with the details of the town or district concerned. The pride of local inhabitants in the mention of their locality on the air is a valuable asset which ought not to be thrown away.

Making Allies

By such means valuable allies can be built up among the populations of the overrun territories, even though we have to bomb them because they fall into the general scheme of German organisation to prosecute the war against us. Without adequate fostering by detailed and localised radio propaganda, our bomb raids, while they will succeed in their immediate objective of maintaining the air blockade, may arouse a feeling of enmity against us upon which the Germans will play to the full at the present time and which will be difficult to eradicate after the war is over.

The two greatest instruments of the war up to date are undoubtedly the aeroplane and the radio. Upon the radio Hitler built up his national strength in Germany. Without radio the German instrument of war would not have become so swiftly the powerful thing it is. And without the aeroplane it could not have swept over Europe as it has in less than a year, nor could it now be threatening the British Isles as it is to-day.

Britain has not made full use of either of these instruments of modern times. In Great War I we had to build up a superlative Air Force before we won the war. We frittered away our supremacy after the war was over.

There is a country saying: "If a man lose his coat, you have to go back to the place where he lost it to pick it up."

We shall have to have a superlative Air Force in numbers as well as quality before we can win this war. And we shall need to have a superlative radio technique to help us win it without making more enemies than we now possess.

Counting Chickens

During recent weeks I have sometimes thought that the radio talks and comments sent out over the British radio were calculated to do more harm than good to the British air blockade. It might be only a coincidence, but a few days before the first great air attack was made upon the London docks a broadcast talk described a journey down the river through dockland, in which the assertion was made that the river had never been so busy loading and unloading ships, and that the war had made no difference to the proud position of the Thames in relation to our mercantile trading between the Thames and nearly every part of the world. What

AIR BLOCKADE (CONTINUED)

an idea to put into the Hitler-Göring mind! Why do it?

I have noticed many things of this kind which I have estimated to be errors of judgment. And as the effectiveness of a blockade must be decided by its effect upon the enemy minus the effect of the enemy counter measures upon oneself, it behoves us to be circumspect about the things we say on the air so that we do not direct the attention of the enemy aeroplanes to targets which they might otherwise ignore.

Of course, I do not say that the attack upon the Thames docks was brought about by that particular broadcast. Photographic reconnaissance was no doubt maintained upon that and many other areas in the country by the German Air Force, just as it is maintained over enemy territory by the R.A.F. But it is unfortunate that the attack should have come so soon after we had broadcast to the world that the Thames was functioning as in normal times. What better answer to that broadcast could the Germans have given? They have had the best publicity.

We have an opportunity before us. We have not yet attacked objectives in Czechoslovakia, Austria and Poland. So we can plan ahead. The representatives of the Governments of Poland and Czechoslovakia in Great Britain ought to be consulted and contribute to the success of the scheme. And the Air Ministry would have to release details of raids sooner than they now do, to enable the scheme to work properly.

Immediately after each raid we should tell the inhabitants of the actual district why the raid was made, what its objective was, and what it will do to speed up the day when they will be released from the overlordship of alien masters. And for the countries which have already known the British bombers—Norway, Holland, Belgium, France—it is time to give them a better explanation of the reasons why we bomb certain localities and objectives, and what is our general plan of action for the freeing of their countries.

If we are to keep them with us it is essential to study the psychology of the peoples whose territories we are unfortunately forced to bomb. And, if we do it cleverly enough, perhaps the fifth column which will one day rise on our behalf to assist in the salvation of those countries, will be able to get to work unobtrusively amid the din of the bombardment of our bombers. Moreover, by carrying out a properly aligned radio campaign along with our air blockade we shall create the outlook needful to enable us to bring real peace to the world after the war is over. Without that radio campaign the work of our bombers might be the prelude to disharmony instead of peace.

We need blockade on the air as well as in the air, and on the sea. All three need synchronisation. And to obtain that synchronisation, plus effective radio co-operation, we need a Minister of Propaganda. A Minister of Information is not enough. The full value of our air blockade must not be thrown away for want of the right words spoken at the right time, to the right place, in the right language.

AN AERIAL RADIO LIGHTHOUSE

New American Omni-directional Beacon

MEMBERS attending a convention of the Institute of Radio Engineers in Boston, Mass., recently were told that the research laboratories of the Radio Corporation of America had, after four years of development work, perfected a new radio range transmitter and receiver that show a pilot at all times his exact position with relation to the sending station regardless of his direction from it.

The new system was likened by Dr. David G. C. Luck, who was chiefly instrumental in developing it, to a marine lighthouse which rotates a horizontal beam steadily in a known time interval and flashes in all directions the instant the beam points due north. To determine his exact direction from the lighthouse, the ship navigator has only to time the interval between the flash and the beam, thereby ascertaining the compass degrees from north.

With the radio lighthouse, called the omnidirectional range beacon, the transmitter at the station sends out a beam that sweeps the horizon through 360 deg. in 60 sec. and also a flash at 1-min. intervals to indicate due north. The instrument operates in wavelengths of ultra-high frequency, which are least affected by static due to atmospheric disturbances and magnetic storms. They also make possible the substitution of five small rods 2ft. long spaced 10in. apart for the 125ft. antenna poles erected 600ft. apart which are required for the long-wave range system.

A small indicator on the instrument panel in the aeroplane is tuned to the wavelength, and shows on the dial a circle of light around which moves an indicating mark in accordance with changes of direction of the plane from the beacon. Direction of this mark from the centre of the dial shows at all times the direction of the plane from the beacon, so a pilot has only to glance at the dial to find his position and correct his course.

If the pilot wants to fly a straight course toward or away from the beacon, he fixes his course by a scale on the face of the instrument and holds the movable mark steady on the circle. Unintentional flying off-course is virtually impossible if he looks frequently at the dial. And in case he must leave his regular course to fly around a storm, he can always know his direction from the radio station by looking at the dial. Drift of the plane from the correct course due to wind is indicated by movement of the mark on the circle and can be compensated for by a change of heading.

Dr. Luck pointed out that present aviation beacons operating on long wave lengths can send direction beams in only a few paths, and if a plane gets off a beam the pilot may have difficulty in determining his precise position with relation to the station. Direction finders with which air transports are equipped to indicate direction of the beam transmitting station from the plane do not operate satisfactorily in the ultra-high frequencies. The need for a direction finder or radio compass, he said, is reduced by the new system, which sends out waves in all directions. Moreover, the dial indication is visual, and the pilot is not dependent upon a distinctive audible tone for keeping on a rather narrow beam.

MASS PRODUCTION

Some Factors Affecting Its Achievement

By ELIZABETH M. G. MacGILL, M.E.I.C.*

WAR in Europe has created a tremendous demand for military and training aircraft, a demand so great that aeroplane factories the world over are busy striving to satisfy it. To increase production is the immediate concern of the whole industry. This concern, however, is not limited to the aircraft companies. So pressing is the need, that aeroplane production has become a matter of national interest and national urgency for neutral and belligerent countries alike. The drive for production is such as the industry never before experienced; yet the accomplishment falls far short of the demand and the output of aeroplane factories the world over is comparatively small. National production figures for aeroplanes would undoubtedly substantiate this last statement. It is difficult, however, to obtain actual figures, especially those for the belligerent nations. However, experts have prepared estimates of probable outputs. Thus T. P. Wright (Reference 1) places the output of military aeroplanes in 1939 at about 22,000 for Germany, 3,600 for the United States, 7,600 for Great Britain, 4,100 for France, or, say, 12,000 for the Allies[1] (including purchases from the United States). Another estimate (Reference 2) of the total number of aeroplanes (all types) produced during the same period, gives 4,775 for the United States, 17,475 for Great Britain, 5,550 for France, 22,550 for Germany, 5,450 for Italy and 9,410 for Russia. That mass production has not hit the aircraft industry is very apparent.

That mass production methods can be applied at will to aeroplane manufacture has been accepted without question by the general public. A production engineer can put anything on a mass production basis, they say, whether it is aeroplanes or baby carriages; it is assumed that there is a close parallel between the automobile and aeroplane industries.

If these statements are true, why then is not the industry on a mass production basis now? Why does aeroplane manufacture lag so far behind automobile production? Three million automobiles were produced last year in the United States in the time it took to turn out five thousand aeroplanes there. Mr. Wright's figures for 1941 show that he does not expect the gap between cars and 'planes to close in the near future, no matter how great the demand. Thus, if the popular conception of the ready applicability of mass production methods to aeroplanes is correct, governments and the public are entitled to an explanation of the delay.

The delay is due to no negligence on the part of the aeroplane manufacturers. Some mass production features have been introduced into the industry. But before the full range of manufacturing technique which transforms quantity production into mass production can be introduced successfully, certain fundamental factors which govern the production *en masse* of all commodities must obtain in the aeroplane industry.

Factors Governing Mass Production, and Examples

Mass production may be defined as the rapid manufacturing of a commodity in large quantities at a decreasing cost per unit produced (within reason). Before mass production techniques can be introduced successfully in an industry, the following factors must govern:

1. Tooling for mass production must be undertaken when the market for the commodity is expanding rapidly.
2. The commodity must be designed for cost and production.
3. The basic design of the commodity must be stabilised.

The automobile and railway freight car are excellent examples of mass-produced commodities and of the operation of the factors listed above.

Some thirty or forty years ago, when the railways were building, there was a growing demand for freight cars, and at that time tooling for mass production was undertaken. A production order for freight cars in those days averaged about 10,000 units, to be completed in a year's time. Similarly, when the demand for automobiles was growing, the motor car companies introduced mass production methods and tools, with the result that from 10,000 to 20,000 units of a single model could be turned out annually. In all industries, once the change is made and the cost of it absorbed, production remains on that basis, even though the demand no longer provides work to plant capacity.

Twenty or thirty years ago, when mass production methods were introduced in the automobile and freight car industries, the design of these two commodities was primarily for cost and production. Design for performance, design for beauty, design for comfort, design for any other specific requirement was given but secondary consideration. Until the emphasis was placed on cost and production, mass production in the two industries was unknown. To elaborate this point—one important step in the design for production is the reduction to a minimum of the number of separate and different parts of the commodity. Comparison of the early automobiles and those of to-day show what has been accomplished along this line. The first motor car bodies were assembled from many different frames, angles, brackets and built-up panels. The modern automobile body is made from four steel pressings. Even though the scope of the automobile has increased, the separate parts of a modern car number only between 500 and 2,000.

When the engineering approach to the problem of the design of a commodity is crystallised, the basic design of the commodity remains stable and unchanging. Stabilised basic design does not imply, however, a similarity of detail design, materials or methods of construction throughout the industry or down the years. These matters must keep abreast of the times, taking advantage of increased engineering skill, new materials developed and new manufacturing processes evolved, even though the fundamental pattern of the commodity to which they are applied remains unchanged. Only when basic design is stagnant can the production engineer function effectively. The basic patterns of the automobile and the freight car were stabilised over twenty-five years ago. Since that time there has been no fundamental change in the design of these two commodities, and this has enabled the production engineer in these two industries to solve his problems with some degree of finality.

Having established the factors governing the successful introduction of mass production methods, we will use them as a yardstick to gauge the feasibility of the mass production of aeroplanes. If these factors obtain now in the industry, we might consider it an indication that mass production of aeroplanes was just around the corner.

Aeroplane Orders and the Expanding Market

That the aeroplane market is undergoing a period of rapid expansion at this time is very apparent. Thus it is astonishing to learn that purchasing orders and production orders are rather limited. Mr. Wright, in his analysis, assumes the average production order for an all-metal aeroplane of modern type to be 400 in the United States, 800 in Germany. Another investigator places the English figure at 1,000. Such production orders result from limited purchasing orders, and that the latter should be restricted appears extraordinary in these times. The paradox of

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[1] He estimates that in 1941 the Allies will catch up with German production (which is still growing) and each will produce about 40,000 aeroplanes annually—providing that bombing of aeroplane factories does not occur.

almost insatiable demand and restricted orders may be explained by the facts that production is slow, obsolescence rapid and the demand of uncertain duration. The expanding market so necessary and attractive to the introduction of mass production methods is at hand, yet wholesale tooling for mass production is not undertaken. The reason for this is the absence of the design factors which govern mass production.

Performance—The Basis of Aeroplane Design

"The commodity must be designed for cost and production." The aeroplane is designed for performance. The design of a new aeroplane is a failure if the performance does not better that of existing machines of the same power and duty. Thus the aeroplane designer faces a dilemma. To insure the marketability of his product—perhaps, too, the supremacy in flight of his nation's Air Arm—he must design for the ultimate in performance. To insure production *en masse*—and perhaps the numerical superiority of his nation's Air Force—he must design to speed up manufacturing. How antithetical these design aims are at present, is shown by the following examples.

To facilitate production the designer is called upon to depart from the streamlined form. This may result in a serious decrease in the speed of his machine[2]. To reduce the number of different parts and thereby simplify production, he must adopt certain standard parts throughout with a resultant increase in the gross weight of the machine. An increase in gross weight of five per cent. of the gross weight may seriously impair the rate of climb (the important characteristic if the machine is an interceptor); or the useful load (fuel, ammunition, bombs), a reduction which would destroy the aeroplane's potency if it were a bomber. Thus under present conditions of design, performance and production are opposed as design aims. Before mass production can be entered upon they must be reconciled, and design for cost and production must assume priority.

Stabilisation of Basic Design

The goal of the aeroplane designer is improved performance—particularly increased top speed. This he can achieve efficiently in two ways—by refinement of the basic pattern and by changing the basic pattern. Refinement of the basic pattern is carried out by incorporating aerodynamic improvements, employing the most improved materials, devising cunning means of saving structural weight, and streamlining the external form to reduce air resistance. Changing the basic pattern implies a fundamental change in the engineering approach. Attempts at crystallisation of aeroplane design pattern are foiled by a change in the basic pattern of the aeroplane, not by refinement of this pattern.

Attempts have been made to crystallise the aeroplane pattern. Seven or eight years ago there was a very general attempt to stabilise design in the form of the braced biplane[3]. This pattern had been followed for years, and its general acceptance (with consequent stabilising of its design, stress analysis and manufacturing techniques) had resulted in continuous development of refinements to performance and production. This highly satisfactory state of affairs changed as the result of the drive for better performance. The braced biplane became obsolete from the standpoint of performance because the aeroplane designer evolved more efficient patterns which gave greater speed with increased cubical content and load-carrying capacity.

The most popular of these modern design patterns is the semi-monocoque[4] monoplane—the reigning design of today. A growing rival is the geodetic[5] monoplane; a promising pattern for the future is the monocoque[6] monoplane. (No such aeroplane has been built yet, owing to lack of suitable material, although development work on promising materials is being carried out.)

The difference between "basic pattern" and "refinement of pattern" now becomes very clear. To each of the four basic patterns mentioned, the common "refinements" of retractable undercarriage and wing flaps are applicable, but this in no way lessens the basic differences between the four patterns. Each pattern approaches the design problem from a different engineering standpoint. Each pattern must develop techniques of its own for design, stress analysis and manufacturing. Many of the engineering techniques of one pattern are inapplicable to the others. The obsolescence of plant equipment and stabilised techniques, and the cost of the new development work are part of the price we pay when we change from one basic pattern to another.

At the present time three of these basic patterns are in use and under construction. The braced biplane is still being built, although its aerodynamic efficiency is inherently less than that of the semi-monocoque monoplane.

The semi-monocoque monoplane is the reigning pattern and the one upon which the industry is concentrating. The geodetic monoplane is an interesting dark horse in the race for performance. The monocoque monoplane looms an imminent possibility—one to raise doubts regarding the advisability of standardising upon one of the other types. Since, by the nature of things, some one pattern will possess greater all-round efficiency than the others, the concurrent building of a number of patterns may be considered a transient phase.

What is the ultimate design pattern for the aeroplane[7]? No one can answer such a question authoritatively. But since mass production has become so necessary in the eyes of the world, the industry as a whole is crossing its fingers, accepting the semi-monocoque monoplane as the ultimate (for now), stabilising on that design pattern and attempting to produce it *en masse*.

Stabilisation of Performance and of Design Technique

In accepting a basic pattern as the ultimate, we accept simultaneously an ultimate in performance. To clarify this latter statement, let us consider the most important single performance characteristic of the aeroplane—level top speed. Had the aeroplane designer accepted the braced biplane as the final pattern (as the industry at one time was prepared to do) aeroplane speeds would have been limited to the maximum that could be obtained by extreme refinement of that pattern—i.e., a limiting level speed of approximately 250 miles an hour[8]. Similarly, when we now accept the semi-monocoque monoplane as the ultimate design pattern we limit the level top speed of aeroplanes to the optimum that can be obtained by extreme refinement of this pattern. This, according to Flader and Child (Reference 3), is a level speed of 650 miles an hour[9].

Such a deduction can be pushed further. Crystallising the basic design has not only set a limiting value on the

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[2] Speaking generally, and considering the effect on performance only, changes in external form affect flying speeds and rate of climb, while changes in gross weight affect rate of climb, ceiling, take-off and landing speeds.

[3] A biplane with externally braced wings, the fuselage of which is a rectangular frame of built-up trusses, faired with wooden stringers and covered with doped fabric, the frame, not the fabric, carrying the load.

[4] A monoplane of which the reinforced covering (skin) of the wings and fuselage takes the loads. The skin is reinforced by internal stiffeners capable of taking compression. Examples: Lockheed and Douglas Transports.

[5] A monoplane the wings and fuselage of which are built of curved "lattices," braced internally and covered with doped fabric. The "lattices" carry the load. Example: Vickers-Armstrongs "Wellington" Bomber.

[6] A monoplane the wings and fuselage of which are each hollow "shells" made of lightweight, rigid material, which takes the loads, requiring no internal bracing.

[7] The basic pattern for the aeroplane only is being considered here. This does not bar the possibility that drastic design changes in the other heavier-than-air craft, such as helicopters and rotating-wing machines (autogyros, gyroplanes, etc.), may lead them to supersede the aeroplane.

[8] Increasing speed by using more powerful engines is at present inefficient due to the attendant increase in weight and dimensions.

[9] Some of the further refinements considered necessary to obtain this speed are: use of new improved wing sections, further reduction in wing area, counter-rotating propellers and increased thrust by recovery and utilisation of waste energy from the exhaust and radiator heat.

level top speed of aeroplanes, it has set an ultimate in performance for each combination of wing loading and power loading[10]. Thus, assuming the happiest design proportions and the utmost in design refinements, 480 miles an hour, say, may be the maximum speed and 5,000 ft. per min., say, the maximum initial rate of climb possible for a semi-monocoque monoplane of wing loading 50 lb. per sq. ft. of wing area and power loading 5 lb. per h.p. These figures would then represent 100 per cent. efficiency for that wing loading and power loading.

This conclusion provides us with a means (undeveloped as yet, so far as the author has seen) of determining at the outset of the design of a prototype the performance limitations which our preliminary decisions place upon the machine. By a series of calculations carried out perhaps as in Reference 3, charts of wing loading, power loading and level top speed, and wing loading, power loading and maximum initial rate of climb could be prepared from which the ultimate values of top speed and maximum climb could be obtained[11]. Conversely, having chosen a desired value for the top speed and maximum rate of climb, the wing loadings and power loadings required to give them could be read from the curves. The efficiency of the prototype designed to such wing and power loadings would be gauged by the approach of its performance to these limiting values.

Incidentally, the importance of the preliminary decisions regarding the design of a prototype become immediately apparent. At the same instant that the basic pattern is chosen, the ultimate performance is determined. Combining two basic patterns results in limiting the performance to a value dictated by the weighted mean of the effects. Thus a monoplane with a fabric-covered fuselage of the open girder type, and a biplane with semi-monocoque fuselage are both inherently slower than a semi-monocoque monoplane. Similarly, the instant that the decision regarding wing loading and power loading is made, the ultimate values of performance are determined. An important part of the designer's job is to make these decisions correctly.

The evolution of routine design techniques is made possible by the crystallisation of the design pattern. Such routines (of which the one suggested above is a poor example) will clarify the designer's problems by showing him exactly where the limits are set, and what steps he must take to obtain the performance desired. Equipped with routine procedures which, while requiring judgment, experience and knowledge to use most advantageously, will assist him to grind out specifications for the prototype, he will be able to shift the emphasis from design for performance to design for production.

Thus, stabilising the basic pattern stabilises performance, which, in turn, encourages crystallisation of engineering design techniques, permitting design for production to be the primary aim. On such terms, mass production methods can be introduced successfully into the industry.

Feasibility of Mass Production Now

Using the yardstick of factors governing the successful introduction of mass production methods, we can gauge the present feasibility of producing aeroplanes *en masse*. A rapidly expanding market—the sound incentive for tooling for mass production—is at hand; there is a general but possibly premature attempt at stabilising the design pattern in favour of the semi-monocoque monoplane; there is a very limited attempt to design minor parts for cost and production, with the primary design aim for performance.

Obviously the industry is not ready for the successful introduction of mass production methods, but due to the tremendous demand, the pressure of public opinion and the financial gains, it is being driven to introduce mass production techniques wherever possible. While this is doubtless the only immediate solution to the war requirements, it will not necessarily succeed in vastly increasing the number of machines built, due to the limitations set upon the introduction of such methods by the aeroplane pattern chosen. Assuredly, more aeroplanes will be manufactured within a given period of time. But production cannot be on an efficient basis, as gauged by quantity and cost, due to the fact that the aeroplane is designed for performance and not for production. To tool to produce aeroplanes as they are designed now is as great an engineering folly as it would have been to tool for the first automobiles as they were designed originally. Modern aeroplane design is still very much in the "bits and pieces" stage that motor car design was formerly before designing for cost and production was undertaken. However, "needs must when the devil drives" and the industry the world over has no alternative but to do what is immediately possible to increase production.

It has been stated above that the present design aim is for performance and that this is responsible for the present manufacturing techniques which, it is claimed here, in general are not mass production methods. To support this contention, it is necessary to outline the present methods of manufacturing adopted universally by the industry and to demonstrate the practical impossibility of producing aeroplanes *en masse* by such methods. Also it is necessary to outline mass production techniques and to demonstrate the impossibility of introducing them unless the machine is designed for production.

Present Production Methods

To appreciate why the present methods of producing the semi-monocoque monoplane are employed, we must recall the methods used in building the earlier pattern. Components of the braced biplane were built separately, and to obtain fitment of components, the essential points of attachment were jigged. Commonly, the fuselage, wings, tailplane, elevator, rudder, fin, ailerons, landing gear and engine mount were built on individual jigs. The usual construction of the plane was a girder-type fuselage of wooden struts and wire bracing, or of steel tubular members throughout, wings with two wooden or metal spars, ribs of wood or metal, and internal bracing of wire and wood or metal members; control surfaces, landing gear and engine mount of metal tubular members. Permanent connections between metal members were made by welding, riveting or bolting; between wooden parts by glueing and nailing. Fittings were of welded plates.

With the stabilisation of the braced biplane pattern, attempts were made to produce the machine in quantity. In many cases, metal superseded wood as the material of construction due to the ease with which metal parts are reproduced and because of metal's greater uniformity and inertness to moisture changes. Attempts were made to design or redesign minor parts for production: manufacturing techniques were developed and adapted to the job on hand. Thus rib templates were introduced on which wooden or metal ribs were constructed rapidly from parts previously cut and formed; ribs were cut from plywood; ribs were stamped from metal sheets. Steel plates were stacked and cut in batches for fittings. Piping, cables and control wires were cut to length and arranged before final assembly. But the great body of work was still carried on on the principal jigs, and in time-consuming fitting work on the final assembly. Thus multiplication of output could only be obtained by multiplication of jigs, men and floor space. Hence, while the construction is simple, and the machine could be and still is produced in quantities, the pattern does not lend itself to mass production.

From experience with the construction of the braced biplane, the industry learned that jigging provided two further advantages aside from ensuring fitment of components. It ensured the interchangeability of components, which was a particular boon to replacement and maintenance in the field, and, in comparison with former methods, it speeded up the production of machines. It was but natural then that when, over a period of time, the popular basic design pattern changed to that of the semi-monocoque monoplane, jigs were accepted as the proper manufacturing technique for the new design. This practice is universally accepted in building the semi-monocoque monoplane, although now it is commonly believed that jigs were introduced to provide quantity production!

[10] Wing loading is the gross weight of the aeroplane divided by the wing area. Power loading is the gross weight divided by the rated horse-power. These factors define numerically the characteristics of sustentation and propulsion of each aeroplane.

[11] Adjustment for altitude would be carried out separately.

The construction of the semi-monocoque monoplane is a fuselage composed of transverse hoops and longitudinal stringers to which the load-bearing skin or metal or plywood is attached by riveting or other means. The wings and control surfaces are of single-, two- or multi-spar construction (the spars being built from formed sections), with tubular internal bracing and metal or plywood covering. The landing gear and engine mount are of tubular metal construction, the former being retractable. This construction is complicated. Intricate sections require a multiplicity of forming operations; closed skin structures present difficult riveting problems. Due to the closed-skin wing and fuselage construction and to the increased intricacy of operating systems the assembling of the "plumbing"[12] is vastly more complicated, and time-absorbing. With the increased size of machines, fuselage jigs and wing jigs have become veritable mastodons upon which are assembled huge components whose time of assembly runs into days and weeks. The semi monocoque monoplane, with its increased size and complexity and new problems of manufacture, takes longer and is more difficult to build than the braced biplane.

The industry seeks to overcome these difficulties by putting minor parts on a mass production basis and by tackling the various "bottlenecks" in the assembly line. Drop hammers and presses are commonly used, especially for small surfaces of double curvature, to speed up production, gain cheapness and meet interchangeability requirements. Obviously, it is quicker, more accurate, and cheaper, if quantity is required, to press out the door of a gun bay than to build it up from separate parts on a jig. Complicated fittings are made from stampings to avoid excessive machining. Castings provide rapid and cheap reproduction of non-structural parts. Time spent on the assembly of components is reduced by breaking down their manufacture into a number of stages. Individual parts are gathered together to form sub-components which are joined into sub-assemblies before being brought together on the main component. The stressed-skin structures are broken into sections for construction. Thus wings are built in sections—a centre section, outer panels and wing tips; or panels are made by constructing the main portion complete with spars, building the leading and trailing edges separately, and bringing the lot together at the final wing assembly. Fuselages are made in halves longitudinally, or in short barrel-like units, the plumbing being completed in each portion before uniting them in the final assembly.

In general the result of such methods is to increase the structural weight of the aeroplane, with attendant reduction of flight performance, and to produce more aeroplanes in a given time than have ever been produced before. But except for the production of minor parts, the technique of mass production has not been introduced into the industry.

Jigs Not Mass Production Tools

Manufacturing by use of jigs is not a mass production technique. Whether the final product is a braced biplane or a semi-monocoque monoplane, manufacturing by use of jigs is limited and multiplication of output can be obtained only by multiplication of the number of jigs with their complement of men and floor space. Thus the element of decreasing cost with increasing output is lacking, while, to make the system even more impracticable, the size, cost of construction and overhead expense of the jigs increase with the size of the aeroplane. Mass production implies getting more products from one tool or jig, not getting more products by increasing the number of tools or jigs. A multiplication of the number of jigs is not a change to mass production methods. The capacity of the jig is so limited that, while it may be considered as a tool to provide fitment and interchangeability, it cannot be considered as a tool to provide rapidity of production. Since the jig is not a mass production tool, the production of aeroplanes *en masse* using the present manufacturing system is a practical impossibility.

The immediate difficulty then is that the present system of manufacturing is wrong from a production standpoint.

[12] Controls, hydraulic lines, electrical cables and piping.

But the system is the result of aeroplane design. This brings us right back to the basic difficulty which is the lack of the fundamental factor governing successful mass production of a commodity—the commodity must be designed for cost and production.

Mass Production Methods

Mass production signifies rapid, cheap production.

To gain rapidity the work must be kept flowing through the factory as exemplified by the conveyor-belt system of automobile construction and the track system of the railway car industry. To provide this, the work must move from small components to the finished article in a large number of easy steps, each operation being a smiple, short-time routine. The bottleneck of final assembly does not exist because the final assembly stage is eliminated in favour of a large number of operations the completion of which is rated in minutes, not hours or days.

To afford cheapness and rapid reproduction the majority of parts must be manufactured by machines. Presses must supplant jigs. Manual labour, skilled and unskilled, must be reduced to a minimum. Differences in parts must be eliminated by standardisation of a few parts, and the number of separate parts must be reduced to a minimum. Similarly, standardisation of semi-finished components such as extruded sections, rolled sections, etc., must be undertaken. For further saving, gauge sizes and approved material specifications must be standardised.

Conclusions

There is nothing new in the mass production techniques outlined above, but they are obviously different from the production methods now in vogue, except as regards the manufacturing of minor parts. Before aeroplanes can be produced *en masse* the proper techniques must be introduced. But the aeroplane built by these mass production methods will be different in construction from to day's aeroplane. Like the first automobile, the semi-monocoque monoplane is all "bits and pieces," being composed of between 3,000 and 20,000 separate parts. Like the first automobiles, the semi-monocoque monoplane is slow and difficult to assemble. Design for production automatically eliminates the semi-monocoque monoplane as the ultimate design pattern.

Before the ultimate pattern for the aeroplane emerges, a great deal more work must be carried out. The basic patterns mentioned previously—the geodetic and monocoque monoplanes—present promising solutions, and are doubtless being explored. As for the present emergency, since we, our allies and the enemy, are all concentrating upon the same discredited pattern, using the same discredited technique, we will suffer disappointment jointly where production *en masse* is concerned.

The production engineer cannot, at will, put any commodity on a mass production basis. Aeroplanes are not like baby carriages. The easy acceptance of the applicability of mass production methods to aeroplane construction arises from sad ignorance of the problems involved.

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[At a time when the man in the street is being fed with unwarranted dreams of aircraft produced by their thousands every month, an article such as the eminently sane and sober review of the subject printed above is most refreshing. It was presented as a paper before the Lakehead branch of the Engineering Institute of Canada, and it is with the greatest pleasure that we give it the wider publicity which it merits.

Some of the statements are epigrammatic in their aptness, and the authoress is to be congratulated on her clear conception of the principles involved. We particularly admire her reference to the jig, which she very neatly puts in its proper place as a tool to provide fit and interchangeability, not as a mass-production tool.—ED.]

PARLIAMENTARY AVIATION

Some Random Notes on the Importance of Keeping the Export Trade Going

By W. S. SHACKLETON

A QUESTION has been asked about our firm in Parliament.

Mr. Hubert Beaumont asked the question and here is the question which Hubert asked:—

"Has the Parliamentary Secretary to the Ministry of Aircraft Production considered the advertisement, a copy of which has been sent to him, inviting Overseas buyers to purchase stock of used aeroplanes and stating that there are over 100 aeroplanes from which to choose; and, as it is not desirable in the present emergency to allow aeroplanes to leave this country, and as such aeroplanes could be of service if only for training purposes, will he exercise his powers to prevent any export of either machines or parts of machines?"

To which the Parliamentary Secretary to the Ministry of Aircraft Production (Colonel Llewellin) replied:—

"Yes, Sir, I have considered the advertisement to which my hon. friend refers and have also procured a full list of the second-hand aeroplanes advertised therein. No aircraft or aircraft parts can be exported from this country without the authority of the Ministry of Aircraft Production, and I can assure my hon. friend that permission is not, and will not be, given for the export of any aircraft which can be used to better purposes in this country than in the Dominions and the Colonies. A large number of aeroplanes in this country which are suitable for elementary training purposes have already been impressed."

That Advertisement

The vulgar advertisement to which Mr. Beaumont referred is our own. It has been inserted in *Flight* and other aeronautical publications since the beginning of the war. We intend to continue it until the end of the war and then expand it enormously because by that time British Aviation will be in an impregnable position with U.S.A. Aviation a good second. Between us we can divide the world's markets!

Now, what was the purpose of Mr. Beaumont's question? Was it a criticism of the Air Ministry and The Board of Trade for permitting us to export aeroplanes in wartime, or was it asked in a genuine desire to acquire information?

If the acquisition of pure knowledge was Hubert's motive, then why didn't he telephone us, write to us, come to see us or even impress us to go to see him?

We could have supplied the information given in the Government's reply, together with other facts which Colonel Llewellin would not feel justified in supplying in an open debate.

It would have saved the time of the House.

It would also have saved the time of important officials at the Ministry of Aircraft Production who had to see us and then sift out all the information we supplied so that the Parliamentary Secretary could prepare his answer.

It would have saved our time, too, because we cannot work 25 hours a day even if we do get up one hour before sunrise.

Whatever Hubert's motive we must in self defence say something about the export of used civil aircraft which work we intend to continue until Hubert passes a law to stop us.

Why should not we export these civil aeroplanes? All of those that we have shipped abroad since this war started had been lying idle since September 3rd, 1939. All of them were taking up valuable hangarage space which can be better employed by regular training or military aircraft.

Many of the owners of these machines were in acute financial difficulties because of hangarage and maintenance expenses, and in some cases hire-purchase difficulties.

Have we not heard that it is important to increase the country's exports? Or have we?

Considering only the present year, 1940, W. S. Shackleton, Ltd., have received orders for very much more than, let us say, £100,000 worth of aeroplanes, engines and spares. Therefore our efforts have brought into this country that amount of outside currency.

And where are the aeroplanes which we have sent from these shores during this present Year of Grace, 1940?

They are hard at work training pilots, or running important air lines, in Australia, Africa, India, the Federated Malay States and other places, but always in places where they will assist the Allied Cause.

In some cases we know that these 'planes are flying almost every daylight hour and many night hours, too, training Empire and Colonial pilots. Perhaps Mr. Beaumont would prefer to see these 'planes still rotting away here through disuse, choking up hangars, a burden on their owners and rapidly becoming out of date and perhaps worthless at the end of this war.

We must not be misunderstood in all this. Some people will ask why these privately and Club-owned machines should not have been put to use in this country. There would be some reason for asking that question, but the fact is that conditions at home are quite different from conditions in the Dominions and Colonies.

Square Pegs

Whereas a club or training school in, say, the Federated Malay States might get along quite nicely with a batch of ten-year-old "Gipsy I Wooden Moths," and another in New Zealand with some B.A. "Swallows," and another in Kenya with Miles "Hawks," and another in South Africa with Taylor "Cubs" (all of which types these clubs may have been using for years), it does not follow that the Air Ministry would find it equally expedient to use these four types—and some fifteen other types—as training aircraft. The thing would be so thoroughly impracticable that many half-wits would readily grasp it. The reason the Air Ministry did not impress all Flying Fleas, for example, at the outbreak of war is precisely that which decided the Admiralty not to impress all canvas folding canoes, and this applies particularly to those canoes which are in leaky condition. Again, do not misunderstand us! We do not export Flying Fleas ourselves—not even to museums—and we export nothing that leaks or drips.

Therefore, as Colonel Llewellin so rightly says, the Air Ministry have impressed a considerable number of aircraft considered suitable for elementary training. W. S. Shackleton, Ltd., with the full approval of the Air Ministry and the Board of Trade, have purchased and exported a considerable number also. And why not? We have been exporting British aviation products suc-

cessfully for ten years. We have taken trouble to study at first hand all aviation problems in all five Continents and in all of our Dominions.

We know that the British aeroplane manufacturer has in past years developed light trainers and small and medium-sized civil aeroplanes of quite distinctive types and superior to those of any other country. That is if excellence is measured by service rendered against cost of rendering it. Associated with these should be mentioned two world-beating engines of small and medium power—the D.H. "Gipsy Major" and the "Gipsy-Six" (And we shall receive nothing for that!)

Overseas owners must acquire spares and replacements to keep those aeroplanes in service, and under present conditions it is a fact that in many cases such replacements can only be obtained by purchasing used aeroplanes and stripping them.

Therefore we intend to continue sending used aeroplanes and engines to those old clients of ours, in spite of Mr. Hubert Beaumont.

P.S.—We still have well over 100 aeroplanes from which to choose. They are all very good aeroplanes, and by a remarkable coincidence they are also very cheap aeroplanes!

THE LATEST DECK-LANDER

Vought-Sikorsky XF4U-1

MODEL XF4U-1 (X for "experimental," F for "fighter") is the name of the latest deck-landing fighter being developed for the U.S. Navy by Vought-Sikorsky, which is a division of United Aircraft Corporation. Initial flight testing was done last month, and the aeroplane is now being turned over to the Navy for its acceptance tests.

This low-wing monoplane, with its "inverted gull wings," is of all-metal monococque construction in which spot welding has been used. A considerable improvement in smoothness of the outside skin is claimed on account of this. The wings are of single spar design, and one reason given for the adoption of the bent wing is that it brings the undercarriage attachment points closer to the ground and so reduces the weight of that component. The right angle joint with the fuselage reduces drag.

The undercarriage is attached unusually far forward on the wing, which must put it considerably ahead of the centre of gravity. It is noteworthy that the nosewheel type of undercarriage has not been adopted; probably because such a design does not offer an easy means of making use of arrester gear. Retraction is backward into the wing and flush doors close over the wheels. A glance at the rudder and fin shows that the rudder is a much larger proportion of the total area than usual.

The XF4U-1 is liberally powered, the engine being an 18-cylinder Pratt and Whitney R-2800. This two-row radial air-cooled is rated at 1,850 h.p. for take-off and 1,600 at an altitude of greater than 20,000 ft. The power is delivered through a Hamilton Standard constant-speed airscrew.

Wing span is about 40 ft. and overall length about 30 ft., while gross loaded weight is near 9,000 lb. No performance figures have been released yet, but it is obviously very fast, and might be in the 430 m.p.h. class. Armament details are also not published, but four gun ports are apparent, two in the upper part of the engine cowling and two in the wings. Those in the cowling probably house machine guns, but the ones in the wings may have something heavier inside.

The large openings in the wings must be air intakes for the carburettor and oil cooler. They are unusually large, but are probably necessitated by the high power of the engine.

Ploughshare Into Sword

THE appeal to the housewives of Britain to yield up their pots and pans was responded to nobly and the results were apparent in a visit made to the premises of a scrap metal merchant and, later, at the furnaces of one of the aluminium alloy companies which is doing the smelting. From being rather forlorn-looking utensils somewhat battered by their bagging up in bales and journeying from the various collecting centres of the W.V.S., they became bright and shining ingots of aluminium of high purity.

The first process to which they are subjected is sorting and what might be called "purification." Standing at benches on which are round blocks of metal used as anvils, the sorters wrench off handles, pull out steel rivets and remove iron beading fires in rims. For any doubtful cases they have a magnet handy for testing. Even cast aluminium handles are taken off, as nothing but rolled or wrought metal is suitable. The output per man is from 3 to 5 cwt. per day.

After this hand-picking process, the pieces are thrown into other receptacles and bagged for transport to the smelting furnaces. There they are shovelled into an oil-fired furnace which, at a temperature of about 800 deg. C., melts them in a few seconds. Pouring is done by hand ladle into large chill ingots, and immediately after solidification they are stamped. Pouring temperature is about 720 deg. C.

Purity of the ingots is very satisfactory and speaks well for the "purifying" done by the sorters. The first 10 ton melt was found to be 99.3 per cent. aluminium, the remainder being mainly iron and silicon, with traces of lead, copper, zinc, manganese and magnesium. The amount of aluminium obtained by the appeal was very good and something like 1,000 tons was handed in by the housewives and others.

Flying Tanker

WHAT is probably the first aeroplane to be devoted exclusively to the transport of fuel oil has been put into service by T.A.C.A. (Transportes Aereos Centro Americanos) which operates in such places as Guatemala, Honduras, Nicaragua and Panama. To avoid the heavy weight of the usual steel oil drum, the oil is transported in bulk in a 600-gallon tank in the cabin of the aeroplane, described in *Western Flying* for August.

The cabin of the Ford tri-motor used was strengthened in the floor immediately under the high wing and the load was carried up to the wing by bracing. The tank itself is of rectangular proportions and about four feet deep. It is criss-crossed internally with a honeycomb of baffle-plates arranged vertically in two directions and also horizontally, to minimise swirl and to strengthen the flat sides The cubic "cells" so formed are about 9 in. each way and communicate with each other by means of large holes in the baffles.

In the bottom are two valves, one being the safety valve for dumping. Unloading is accomplished through the other one in six minutes into underground storage tanks built at each aerodrome Loading takes eight minutes. Design and construction were done entirely by the staff of T.A.C.A.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of our writers, not necessarily for publication, must in all cases accompany letters

WOMEN FERRY PILOTS

The Opposite View

IN view of the gross inaccuracies contained in Mr. Pinkerton's letter published in your issue of September 5, it seems rather necessary that someone should suggest a modification of his views, which are clearly based upon a very small knowledge of the true position relating to ferry pilots in the A.T.A.

In the first instance of forming A.T.A. it was realised that there were several useful pilots quite capable of delivering machines over comparatively short distances, being at the same time not sufficiently youthful or physically fit to stand up to the strain of flying in action. It was also foreseen, taking the long and correct view, that the day would arrive when the expansion of the R.A.F. would make its call upon practically every available and potential pilot. With this in mind, a small body of eight highly skilled and experienced feminine pilots was formed in the nature of an experimental pioneer venture. Such has been the quality of their work, and so highly do competent authorities value their services that the number has now been increased to twenty. It would probably be a revelation to Mr. Pinkerton to observe the tremendous keenness and self-sacrifice that these undeniably over-worked girls invariably display. In answer to his slightly ridiculous claim that there are "thousands of pilots" who could do the job, there is little doubt that A.T.A. would be more than delighted to hear from any of them sufficiently qualified, in view of their frequent and agonising appeals for more pilots!

In closing, I would like to make the sincere suggestion to Mr. Pinkerton that, remembering the very practical and troublous times in which we live (to say nothing of the shortage of paper), he might be serving his country much more zealously by giving up less of his time to writing disrupting and ill-informed letters to the Press, or publishing even less valuable pamphlets, and rather more of his time to a useful and constructive service, such as the now well-proven A.F.S. or A.R.P. bodies.

J. R. WATERMAN.

THE AIRCRAFT INDUSTRY

Designing for Production

I HAVE read with interest the article on the above subject by Mr. Bird in your issue of August 22, and I am glad to note that he is in agreement with me except on one point. We differ on the question of easing inspection. Let me quote Mr. Bird a few recent examples:—

1. A parent firm's inspector stated that he was not prepared to accept the partly-completed components for an aircraft, due to the fact that one part in the assembly had not been produced in accordance with the firm's practice. This meant a complete stoppage on the job, since the sub-contractor had not the equipment to carry out the revised operation, and components would require to be dismantled to remove the offending part. The matter was investigated by the sub-contractor, and he was able to prove that the parent company had not the equipment to carry out the suggested operation, and also that a few thousand components had been made by the parent company with the same type of treatment then in operation at the sub-contractor's plant. The result was an apology, and an admission that the inspection department were not aware that the part was given the treatment mentioned in their own plant.

2. A batch of high-tensile steel bolts were rejected due to the diameter over the top of the threaded portion being 0.005in. under nominal size. After explaining to the inspector that it would not matter if this error was three times the amount mentioned, and that the correct way to check a screw was on the effective diameter, the rejection was withdrawn.

3. During the treatment of certain parts the inspector insisted on alterations being made on the treatment as it proceeded, with the result that, as might have been expected, the parts were rendered unusable.

Comment on the three examples given is needless.

Mr. Bird appears to have had troubles with the drawings issued to sub-contractors by aircraft firms, but I suggest that some drawings are not suitable for issue to sub-contractors at all, due to missing dimensions and limits. In some cases no drawings exist for parts which the sub-contractor has to make. In one instance the drawings did not agree with a very important part, as the vital locating portion was not shown on the drawing.

I agree with Mr. Bird that the British Aircraft Industry is conservative in regard to the pooling of ideas, but there are conservative ideas held about sub-contractor's suggestions, as the following will show.

About six months ago a suggestion was put forward to start a well-equipped firm on the production of three vitally important parts for aircraft. This suggestion was rejected. A second request was turned down, although it was explained that there was a definite shortage of the parts, and that aircraft were being held up. A recent visit to this firm found production under way. Why was it necessary to wait six months?

Another suggestion was put forward to replace a special machine which could not be obtained with a standard existing machine to produce the part more quickly, the layout being given. This was turned down, as the special machine would be supplied, but at the end of two months it was admitted that the special machine could not be produced.

Affairs are too critical in the aircraft business at present to allow for any delay, mistakes, or personal considerations to arise. We have too much at stake.

"SUB-CONTRACTOR."

DISTINGUISHING NOISE

German Engines Unmistakeable

UNDOUBTEDLY a German raider can be distinguished by its noise, certainly the twin-engined types, which emit an irregular beat or reverberating note. I have had dozens of opportunities of proving my diagnosis as bombs have fallen from machines identified. Two British single-engined planes do not give the same note to experienced observers, the exhaust is higher pitched and the supercharger whine more pronounced.

Incidentally, I was interested in your reference to single-engined German raiders last week. Unless my ear and judgment were deceived I, too, identified them by their entirely new and raucous note.

I assume from talks with friends that all Londoners are glad that such effective A.A. fire now keeps the raiders at bay, or very high, when occasional machines penetrate the barrage.

EX R.F.C.

THE R.A.A.F. GETS BIGGER

Five Times Its Pre-War Size

THE personnel of the Royal Australian Air Force is now five times as great as it was at the start of the war, now comprising a total of 18,130.

At September, 1939, there were 310 officers and 3,179 men. These figures are now 1,250 officers and 16,715 men and some cadets. And the growth will continue, for there are 4,798 recruits waiting to be trained as air crews, and 6,543 for work on the ground.

During July 332 trainees started on their air work, making a total under instruction of 1,415. The first of the Australian air crew trainees to go to Canada are expected to leave for that country in September to undergo a course of 16 weeks.

Ten of the 22 training schools due for establishment this year have been opened and more will be opened shortly. Another service flying training school was opened in New South Wales, and at the central flying school in the same State instructors are being trained or given refresher courses. There are also schools for observers, radio operators, air gunners and bomb aimers, and an air navigation school is to be opened in November.

Recruit depots for preliminary training in drill and routine have been set up in Victoria, New South Wales and Western Australia, and schools of technical training are at work in Sydney, Melbourne, Adelaide and Canberra.

HERE and THERE

Douglas DC2 Airliners

IT is reported that the British Government has bought ten Douglas DC2 airliners from Eastern Air Lines in U.S.A. The purpose to which these aeroplanes will be put has not been stated.

Ford to Build Aero Engines

A FACTORY to cost £1,000,000 will be constructed for the Ford Motor Company in which they will build Pratt and Whitney aero-engines. An order has been given for 4,000 engines. It is expected that the factory will be completed by January 1 next year and production may start on March 1. The sum of £1,750,000 will be spent on tools and equipment.

Wing Cdr. Fielden Engaged

THE Captain of the King's Flight, Wing Cdr. E. H. Fielden, has become engaged to Miss M. A. Ramsden-Jodrell, daughter of Lt.-Col. and Mrs. H. Ramsden-Jodrell, of Whaley Bridge, Derbyshire. For the last 12 years Wing Cdr. Fielden has been the personal pilot to the Royal Family and since 1936 has been an Equerry to the King and Captain of the King's Flight. On the outbreak of war he was released from this duty to serve again with the R.A.F.

Praise for the Workers

LORD BEAVERBROOK has sent a message of thanks to the workers in the airframe and engine factories and in those of the related industries for standing on duty and maintaining their output through the first week of the London Blitzkrieg which started on September 7.

"It has been a remarkable demonstration of fortitude and endurance," he states. "The devotion to the nation that has been displayed will make a new and splendid chapter in the history of British courage."

Flight echoes and applauds his statements for we well know the courage that is needed to keep steadily at tasks in such parts of the factories as the foundries with their furnaces of molten metal. What might follow the landing of a bomb near such a furnace does not bear too much thinking of, but the workers keep going. They are backing up the Royal Air Force with courage and long hours of work.

Buckingham Palace Bombed

BUCKINGHAM Palace has been bombed three times in the last few days, but with ineffective results. On September 10 a time bomb exploded and damaged the swimming pool and some of the apartments in the north wing. Their Majesties' private apartments were littered with some of the debris, but they were not in residence. The bomb was reported to be a 250-pounder and to have penetrated some 10ft. deep.

Then on September 13 a definite attempt was made by a single bomber. Favoured by low cloud, the attacker approached under cover. When near the Palace he descended out of the cloud, dropped five bombs and in a few seconds had climbed again out of sight in another cloud. The attack on what, to the Germans, is no doubt a "military objective," was a daring one in that the pilot descended lower than the balloons and risked encountering the cables.

The third attempt was made two days later, but it is uncertain whether this was an "aimed" attempt or whether some of the numerous indiscriminate bombs simply fell near the Palace. There have been no fatalities in any of the bombings, and only four men were slightly injured.

The chest air pump is provided to keep this rubber boat inflated. It was captured from a Dornier Do 17.

American Production Grows

MR. W. S. KNUDSEN, chairman of National Defence Commission, said that the present production of military and large commercial aircraft was at the rate of 900 per month and that this would be doubled in the next twelve months. He expects that by April 1, 1942, there will be a total production of 33,000 aeroplanes, 14,000 being for Britain and 19,000 for the U.S. forces.

Air-raid Distress

A FUND has been opened by the Lord Mayor, Sir William Coxen, for the relief of distress caused by the bombing of London, and many donations have already been made to it. The principal gift is £250,000 from the Lord Mayor's Red Cross and St. John's Fund, and this money can be applied either in cash or in kind for the relief of urgent distress. The King has sent £1,000, the Queen £500, Queen Mary £500, the Duke and Duchess of Gloucester £250, and the Duke and Duchess of Kent £200. The London County Council has sent £5,000.

The Mayors of Capetown and of East London (in South Africa) are both opening funds, and Melbourne, with an objective of £A250,000, has already subscribed £A80,590. The Australian Red Cross has voted £A25,000 and Sydney is launching an appeal. The War Purposes Fund of India sends £35,000, and New Zealand has responded with the large sum of £100,000.

Gifts of clothing as well as money will be welcomed. Cheques should be made payable to "The Lord Mayor's London Air Raid Distress Fund" and crossed "Bank of England." They should be addressed to the Mansion House, E.C.4.

Speed Testing

A NEW photo-electric device for timing aircraft over measured speed courses has been demonstrated at Los Angeles. It consists of photo-electric cells coupled by an amplifying system to a clock mechanism. The device is arranged in vertical tubes placed on the runway and the photo-electric cell is operated by the shadow of the aeroplane passing over it. This sets the clock mechanism going and a similar arrangement at the end of the speed course is operated to stop the clock, again by the aeroplane's shadow.

The Laryngophone

THE use of a microphone which picks up speech by being held in front of the mouth is subject to the disadvantage that atmospheric noises are picked up also. To eliminate this trouble, the laryngophone has been developed and this picks up its sounds by direct vibration when held in contact with the larynx. Either a crystal or carbon microphone may be used, the former giving better quality, while the latter has greatest sensitivity. This invention may have an application in the cockpits of aircraft where the noise level is relatively high and has another advantage in that it can be used when wearing a gas mask. The device can also be fitted to the handpiece of a telephone.

U.S. Civil Pilot Training

THE Civilian Pilot Training Programme, which is charged with the task of training 50,000 pilots by June 30, 1941, has commenced the flight training of 17,494 of them and has 32,000 students at work on the ground part of their course. About 1,000 civilian instructors are being given refresher courses and will then be added to the teaching staffs.

Ground schools have been opened at 499 colleges and universities and flight training is available at 528 commercial flying schools. The students enrolled for instruction at these schools number 15,980. On July 1 an additional 15,000 students were enrolled from non-college sources and began ground training at 202 stations.

A new phase has been added to the scheme and secondary training will be given to about 9,000 students this year. Aeroplanes of the army trainer type will be used in this work. Refresher courses also are to be offered to former pilots whose licences have lapsed, and research laboratories are working on experiments designed to improve methods of training.

MODERN TECHNICAL DEVELOPMENTS

Shaft Drive : Dynafocal Suspension : Superchargers

WHAT does the future hold for the science of flight? Assuredly more than can be published at the present time, with its strict censorship. But in every country in the world, belligerent, neutral or non-belligerent (which term is one more subject for the international lawyer to write learned volumes about) research is going on. Higher speed, greater armament, larger size, longer range—all are being sought continuously. Generally the aim is for more effective defence or offence, but some of the scientific work being done will have its value later in peaceful development, when maybe some of the military aircraft of the world will be no longer needed, and the present order will be reversed and aeroplanes will be beaten into pots and pans.

We publish hereunder some current technical abstracts which show the trend of scientific work in aeronautical engineering at the present time. They are issued by the Directorates of Scientific Research and Technical Development, Air Ministry, and prepared by R. T. P.

Supercharger Research

As the first step in the investigation of altitude performance, the power of the engine cylinder under all possible conditions of manifold pressure, manifold temperature and exhaust pressure must be determined. Describing the single-cylinder laboratory at his company's plant, the author states that it is possible to produce in this laboratory any desired exhaust suction; manifold pressures up to 150in. Hg.; inlet air temperature up to 400 deg. F.; and to handle engine speeds up to 5,000 r.p.m.

Maintenance of power at altitude by means of the exhaust-driven turbo-compressor affords a most convenient way out for the engine manufacturer; the troubles, if any, are transferred to the builder of the turbo and of the aeroplane. The author considers "worthy of considerable attention" the use of a two-stage supercharger with an auxiliary engine to drive the first stage. This arrangement is especially applicable to large aeroplanes.

Other supercharger arrangements discussed are the single-stage geared compressor; two-speed drives; continuously variable drives; two-stage geared superchargers; and modified two-stage installations such as two-speed both stages, by-passed first stage and the two-speed first stage.

The two-speed first-stage method of using two stages is the most satisfactory yet considered since three steps of supercharging reduce the amount of throttling required and, therefore, improve the overall efficiency of the system.

Altitude Performance of High Output Aircraft Engines (Digest). (R. N. DuBois, J.S.A.E., Vol. 47, No. 1, July, 1940, p. 28.)

Power at Altitude

The aircraft-engine manufacturer's 1 lb. per h.p. at sea level becomes 2 lb. per h.p. at 20,000 ft. unless the utmost in engineering skill and ingenuity is put into the problem of increasing altitude output.

Comparing the effects of various methods of supercharging upon the engine power output and specific fuel consumption, as operating altitudes are increased, either the two-stage supercharger or the exhaust turbo method of supercharging appears to be required. For high-altitude operation, the exhaust turbo in conjunction with the two-stage supercharger seems to offer the maximum in horsepower output, but with considerable installation complication. For low-altitude operation, the "single-speed non-intercooled engine offers the maximum output with a minimum of installation complication."

The principal factor retarding development towards improved economy and higher specific output is the difficulty of obtaining precise and comprehensive data under actual flight conditions due to the lack of suitable flight test facilities. The capital expense necessary to provide one or more aeroplanes suitable for modern engines is very great, and the time element cannot be overcome at the present pace of the industry which is concentrating on development of new types of engines.

It appears that data obtained in flight with the torque meter provide excellent substantiation of the empirical formulæ used for the determination of engine performance at altitude. Fuel consumption at altitude is related definitely to the power and speed values required for the aeroplane operation. For a given supercharger speed ratio, the minimum specific fuel consumption values are obtainable only at the lower altitudes, and curves of engine fuel requirements must be correlated suitably with the altitude power curves of the engine before such curves are of practical use.

Altitude and the Aircraft Engine (Digest) (E. F. Pierce, J.S.A.E., Vol. 47, No. 1, July, 1940, p. 28).

An Extension Shaft

The Junkers shaft has internal vibration dampers. It is nearly 6.5ft. long and weighs 161 lb., including the propeller bearing, and is used to transmit the torque from a Jumo-205 Diesel engine to a pusher propeller. Each additional foot of length between the propeller and engine entails an extra weight of only 11.5 lb. The shaft extension does not require attention or servicing in flight, so that no extra burden is placed on the crew.

The straight-line propeller-shaft extension also enables the torques of a number of engines to be combined in a common gear box and passed to a single propeller. Of course, such arrangements require the fitting of clutches which can be actuated at will while the power plant is in operation, since provision must be made for starting, warming up, and stopping (in case of trouble) each engine separately with the propeller at a standstill. A free-wheeling device is also necessary for each engine, so that a defective one may be disengaged from the rest without affecting the proper performance of the power unit.

Jumo 205 Diesel Extension Shaft on the Dornier Do.18 Flying Boat (Mech. Eng., Vol. 62, No. 8, Aug., 1940, pp. 615).

C.G. Support

Dynafocal suspension is described as a directional spring mounting system which accomplishes a true centre-of-gravity support for an overhung mass, and provides sufficient flexibility for the absorption of both angular and translational vibratory disturbing forces, without undue loss of stability for the supported assembly.

The name "Dynafocal" represents the term under which this system of engine mounting is being marketed. It is a combination of the original name, "dynamic suspension," and perhaps a more descriptive term, "focalised support." Credit for the conception of the focalised suspension should be given to the Massachusetts Institute of Technology, and practical development of the link method of application is credited to Wright Aeronautical Corporation.

This paper reviews the principles underlying the design and describes the Dynafocal suspensions now in use with the idea of showing the practical benefits which can be provided through the application of these principles.

Dynafocal Suspension for Radial Aircraft Engines (Digest) (T. L. Yates, J.S.A.E., Vol. 47, No. 2, Aug., 1940, p. 30).

SERVICE AVIATION

Seeing How : Their Majesties the King and Queen with Sir Hugh Dowding, Air Officer Commanding in Chief Fighter Command, during their recent visit to see how enemy air raids are handled by our fighters. An air battle was in progress during the visit.

Duke Lunches in Shelter

ON September 7, Group Capt. the Duke of Kent, made an extensive tour of the Kent area.

In the morning he inspected an aircraft factory and during his visit to a nearby aerodrome an air raid warning was sounded. The Duke completed his inspection. Four minutes after he left, bombs were dropped near the aerodrome. The Duke lunched in an air-raid shelter many feet under the chalk cliffs.

In the afternoon the Duke called upon a battalion of a regiment of which he is Colonel-in-Chief. Later he called on Vice-Admiral Sir Bertram Ramsey at Dover, and witnessed a lively air battle over the Channel. He also visited an Observer Corps post in the Dover area.

Volunteer Air Crews

THE continued growth of the Royal Air Force, which has been facilitated by the greatly increased production of aircraft, requires the maintenance of a regular and adequate flow of suitable personnel from home sources for air crew duties. Since the beginning of the war the requirements within this country have been readily met by the entry of volunteers from civil life, from within the Service and from men who have already expressed a preference under the National Service Acts.

With the increase of flying training facilities it is now possible to offer new opportunities for personnel to be entered for air-crew training in the near future. Applications are therefore invited for air-crew service-pilots, air observers and wireless operator/air gunners, from the following age groups:—

(a) Men aged 18 and 19 and those who have become 20 years of age since the last registration under the National Service (Armed Forces) Acts on July 27th, 1940. Candidates should apply to the Royal Air Force Section of the nearest Combined Recruiting Centre. In the London area information concerning air crew service may also be obtained from the Air Ministry Information Bureau, Adastral House, Kingsway, W.C.2.

(b) Men between 20 and 32 years of age already registered for any of the Services (other than air crew duties in the Royal Air Force) but who have not yet been posted.

Men in these groups can still be considered for air crew duties if they notify the Employment Exchange at which they registered that they now wish to serve in this capacity. The maximum age for pilots has been extended to 37. For the other classes it remains at 32.

Candidates must be fit, intelligent, and possess dash and initiative. Their general education, either at school or during their subsequent career, should have been above elementary standard. The number of aviation candidates Selection Boards has recently been increased and candidates can normally be examined without delay.

Successful applicants are advised not to relinquish their civil employment until they have been notified that they are required to begin their Service training.

Awards

THE King has been graciously pleased to approve the undermentioned appointments and awards:—

COMPANIONS OF THE DISTINGUISHED SERVICE ORDER.

Act. Wing Cdr. W. C. Sheen, Act. Wing Cdr. L. F. Sinclair.

DISTINGUISHED FLYING CROSS.

Wing Cdr. J. E. W. Bowles, Act. Wing Cdr. J. C. Sisson, Sqn. Ldr. K. B. B. Cross, Sqn. Ldr. D. P. Hanafin, Sqn. Ldr. R. G. Harman, Act. Sqn. Ldr. F. A. Wilkin, Flt. Lt. G. F. Chater, Flt. Lt. G. R. Edge, A.A.F., Act. Flt. Lt. C. A. Baskett, Act. Flt. Lt. T. H. Boylan, Act. Flt. Lt. W. W. Campbell, Act. Flt. Lt. W. D. Corr, Act. Flt. Lt. B. O. Dias, Act. Flt. Lt. F. E. Eustace, Act. Flt. Lt. I. R. Gleed, Act. Flt. Lt. C. S. P. Russell, F/O. I. K. P. Cross, F/O. D. A. Fordham, F/O. A. R. Gibbes, F/O. D. H. Jacklin, F/O. R. Lloyd, F/O. R. J. Peacock, F/O. R. W. Reynolds, F/O. G. R. Taylor, F/O. G. H. Wherry, P/O. P. V. Arderne, P/O. R. W. Ayres, P/O. R. R. Banker, P/O. C. G. Birch, P/O. F. J. Curtis, P/O. G. K. Gilroy, A.A.F., P/O. J. C. Hall, P/O. G. D. Lyster, P/O. G. B. Murray, P/O. W. E. Nicholas, P/O. R. M. North, R.A.F.V.R., P/O. E. F. J. Odoire, P/O. C. D. Stenrer, P/O. F. J. Watson.

BAR TO THE DISTINGUISHED FLYING MEDAL.

Sgt. G. Allard, D.F.M.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. R. T. Langton, Flt. Sgt. (now Warrant Officer) J. B. Robertson, Sgt. G. Ashmore, Sgt. B. Bardega, Sgt. G. L. Barker, Sgt. A. S. Beeby, Sgt. A. J. Box, Sgt. J. M. W. Briggs, Sgt. F. G. Brook, Sgt. N. W. Brown, Sgt. J. R. Caister, Sgt. C. W. Cowan, Sgt. A. B. Cox, Sgt. E. P. Davidson, Sgt. C. E. A. Dunlop, Sgt. S. Glazebrook, Sgt. W. T. Gray, Sgt. K. H. Harrison, Sgt. W. F. Horner, Sgt. A. Johnson, Sgt. D. Mackay, Sgt. L. J. Maidment, Sgt. N. Paxton, Sgt. J. W. Potter, Sgt. S. C. Redhead, Sgt. G. R. Roscoe, Sgt. H. Shields, Sgt. H. Silverwood, Sgt. N. P. Simmons, Sgt. A. F. Skelton, Sgt. H. Smith, Sgt. M. G. P. Stretton, Sgt. D. A. Templeton, Sgt. C. E. Vince, Sgt. J. Wells, Sgt. K. W. Wright, L. A/C. N. Deighton.

Royal Australian Air Force

DISTINGUISHED FLYING CROSS.

Sqn. Ldr. W. N. Gibson, Flt. Lt. J. A. Cohen.

Royal New Zealand Air Force

DISTINGUISHED FLYING CROSS.

Flt. Lt. A. A. N. Breckon.

The above awards are for gallantry and devotion to duty in the execution of air operations.

Roll of Honour

Air Ministry Casualty Communique No. 45.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed.

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—P/O. K. H. Cox, 81367; Sgt. R. P. Hawkings, 748627; P/O. P. E. O. Jago, 40916; Sgt. W. H. Machin, 968717; L.A/C. A. H. W. Matthews, 534629; F/O. G. E. Moberly, 90332; Sgt. P. K. Walley, 819018; P/O. F. K. Webster, 82682; Sgt. J. A. Wilson-Law, 580723; Cpl. J. H. Wintle, 519946; Sgt. D. L. Wright, 552618.

PREVIOUSLY REPORTED "MISSING BELIEVED KILLED IN ACTION." NOW PRESUMED "KILLED IN ACTION."—Act./Sgt. R. Ballantyne, 580780; L.A/C. A. A. Brown, 551008; F/O. H. L. McL. Bulloch, 37788; L.A/C. W. Greig, 532769; D. H. Grove, 629162; Sgt. D. J. Kirkness, 565269.

PREVIOUSLY REPORTED "MISSING," NOW PRESUMED "KILLED IN ACTION."—L.A/C. F. Birch, 540261; Sgt. A. E. A. Bruce, 740984; L.A/C. A. R. Chapman, 534704; Sgt. L. C. Cond, 580724; Fl. Sgt. A. Hill, 590599; P/O. N. Hawxby, 39735; L.A/C. T. F. Johnson, 538052; L.A/C. F. G. Jones, 567277; A/C.1 S. N. Middleton, 611040; Sgt. G. H. Tice, 507671; Sgt. J. H. Wadmore, 564478; Sgt. T. S. Weightman, 564455.

PREVIOUSLY REPORTED "MISSING BELIEVED KILLED IN ACTION," NOW REPORTED "KILLED IN ACTION."—P/O. J. W. Bland, 90895; Cpl. J. Clark, 566218; L.A/C. W. Crossland, 522035; Sgt. W. C. H. Style, 521075.

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "KILLED IN ACTION."—Sgt. A. Aitken, 513170; Sgt. F. Checkley, 580605; L.A/C. D. V. Cleaver, 548680; Act. Flt. Lt. F. N. Clouston, 40990; Sgt. G. F. Couzens, 565544; Flt. Sgt. J. C. Dawson, 545075; P/O. J. Eadie, 33473; Sgt. A. Evans, 552163; Sgt. A. Glen, 629156; P/O. A. C. Hamilton, 78543; Sgt. E. Hill, 633167; A/C.1 W. C. Hubbard, 625793; Sgt. A. K. R. Keats, 528054; Sgt. S. C. Kirkbride, 566117; P/O. H. F. A. Lees, 78545; F/O. D. W. Lindsay, 39018; Sgt. J. F. McCauley, 564908; F/O. J. T. Marinnis, 37753; Sqn. Ldr. J. G. Macintyre, 36015; Sgt. F. Nelson, 516778; Sgt. A. I. J. Nicol, 543932; Sgt. A. J. Roberton, 590388; P/O. E. A. Saunders, 77342; P/O. W. A. Saunders, 40756; F/O. H. J. Seagrim, 39176; Sgt. G. F. Sexton, 755373; Flt. Sgt. W. T. J. Southey, 514566; Sgt. C. W. Thorley, 751531.

WOUNDED OR INJURED IN ACTION.—P/O. N. Bicknell, 73041; Sgt. A. H. Bolton, 357613; Sgt. R. Carnall, 563058; P/O. H. D. Clark, 33382; Sgt. G. T. Clarke, 748034; Sgt. N. C. Cook, 740487; Sgt. J. L. Crisp, 748004; Sgt. R. Edwards, 742809; P/O. R. Lane, 41028; F/O. C. H. Maclean, 90166; P/O. H. L. North, 41608; Sgt. R. C. Robson, 552489; Act. Sqn. Ldr. H. A. B. Russell, 37692; F/O. R. F. Smythe, 40436; Flt. Lt. M. G. Stevenson, 33290; Flt. Lt. J. D. Urie, 90164; P/O. G. D. Waterer, 77214.

"DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION."—Sgt. H. V. Watts, 650383.

"MISSING, BELIEVED KILLED IN ACTION."—L.A/C. E. C. Clarke, 568541; Sgt. A. T. Gay, 565559; Sgt. J. H. George, 626245; Sgt. M. M. Shanahan, 741623; Sqn. Ldr. C. W. Williams, 26219.

MISSING.—P/O. H. D. Atkinson, D.F.C., 33418; Sgt. F. A. Beale, 741185; Sgt. S. L. S. Belton, D.F.M., 581261; P/O. N. J. B. Benson, 73485; Sgt. A. Berry, 968035; Sgt. J. Brooke, 745993; Sgt. R. J. Buckley, 987890; Sgt. H. Chambers, 632993; Sgt. R. D. E. Clarke, 580869; Sgt. G. R. Collett, 745500; Sgt. G. Davies, 552076; Act. Sgt. L. G. Davies, 504802; Sgt. J. L. Dewhurst, 580488; Sgt. M. P. Digby-Worsley, 649007; Sgt. K. H. Dobb, 745629. Sgt. T. S. Duncan, 521725; P/O. K. R. Gillman, 42053; Sgt. A. J. Griffiths, 581384; Sgt. L. N. Guy, 758223; Sgt. H. Haggett, 626994; Sgt. W. F. Haywood, 628965; L.A/C. E. G. Hillyard, 747947; Sgt. W. A. Hughes, 563882; Sqn. Ldr. P. A. Hunter, D.S.O., 32081; Sgt. C. J. A. Ive, 747985; Sgt. S. G. Jermond, 524198; P/O. J. T. Jones, 78855; Sgt. M. Keymer, 748504; P/O. F. H. King, D.F.M., 43845; L.A/C. L. Laurie, 799685; Sgt. L. M. Lowry, 649386; Sgt. D. Mackay, 551045; Sgt. H. J. Marsh, 562584; P/O. A. G. Middleton, 78251; Sgt. H. F. Montgomery, 741305; Sgt. A. Morgan, 651574; L.A/C. A. H. Nicoll, 548549; Sgt. J. Patterson, 631112; Sgt. R. L. Peacock, 740307; Sgt. A. M. Pillans, 751549; Sgt. M. W. J. Pollard, 742311; P/O. W. A. Ponting, 79217; P/O. B. Reynolds, 42528; A/C.1 J. M. Roberts, 634663; P/O. A. Robson, D.F.C., 41471; F/O. M. H. Rogers, 40432; F/O. E. H. Ross, D.F.C., 40060; Sgt. J. H. Round, 740667; Sgt. P. D. Salmon, 551589; Sgt. K. A. Sayer, D.F.M., 548614; Flt. Lt. J. S. Scott, 37484; F/O. I. G. Shaw, 40265; Sgt. F. L. Smith, 580384; P/O. C. Stewart, 44231; A/C.2 J. D. Stuart, 639318; L.A/C. C. H. Taylor, 352704;

Royal Air Force Awards and Official Announcements

SERVICE AVIATION (CONTINUED)

Sgt. G. Thompson, 652725; P/O W. F. Tudhope 41224; Sgt. R. L. Wake, 580685; Sgt. W. H. Want, 745927; Sgt. W. G. F. Whiting, 581252; P/O. T. S. Wildblood, 33478; Sgt. W. G. F. Wilkinson, 546143; Sgt. A. A. Wilmot, 751064; P/O. D. L. Wingate, 33470; P/O. D. N. Wooster, 42666; Sgt. L. R. Youngs, 580905.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION.—Sgt. J. Bishop, 754664; Sgt. S. Britnor, 754172; Sgt. J. D. Gwynne, 742137; A/C.2 J. A. Jackson, 651960; P/O W. E. King, 81356; Sgt. W. C. Munro, 755916; Sgt. O. J. Weeks, 370398.

KILLED ON ACTIVE SERVICE.—L.A/C P. C. Anscombe, 747343; Cpl. G. Atkinson, 565463; Cpl. W. F. Bateman, 563962; Act. P/O. D. M. M. Bell, 42784; Sgt. J. S. Bell, 754390; P/O. L. W. Bennett, 41820; Sgt. J. N. Bilton, 936831; A/C.2 G. Booth, 943762; A/C.1 L. E. Brookes, 573086; P/O. F. J. A. Cameron, 79525; Sgt. R. W. Clapperton, 530058; L.A/C. W. Collerton, 526331; A/C.1 A. G. Couling, 749792; L.A/C. J. W. G. Dell, 610506; Sgt. D. W. Dennis, 755456; L.A/C. A. F. Doncaster, 567998; Sgt. D. Duncan, 754488; L.A/C. A. E. Gainey, 356359; L.A/C. B. A. Haines, 903690; L.A/C. P. H. Halley, 517019; Sgt. B. Hancock, 742644; A/C.1 L. B. Harris, 976057; P/O. A. T. Harrison, 42604; A/C.1 R. H. Harrison, 911733; L.A/C. R. O. Hewlett, 614759; L.A/C. A. J. Hoare, 342664; L.A/C. J. A. Hodgson, 944900; L.A/C. R. T. Howard, 902551; L.A/C. G. D. Hulse, 936159; A/C.2 H. B. E. Hurley, 913596; A/C.2 A. Jones, 949725; A/C.2 R. G. Jones, 1171578; A/C.2 I. H. King, 645505; Cpl. W. H. Lewis, 350025; L.A/C. T. H. Lovett, 238427; P/O. R. S. Magee, 36256; Sgt. D. M. P. McGee, 745035; A/C.1 B. W. Mills, 749734; L.A/C. T. J. Mortimer, 639246; A/C.2 J. G. Moverley, 547322; Act. Sq. Ldr. E. L. Moxey, 73498; F/O. G. E. Newton, 37824; Sgt. E. W. Osbourne, 742135; L.A/C. J. E. Parish, 917250; F/O. W. F. Parkinson, 1903; A/C.1 S. T. Philbrick, 628255; A/C.2 E. N. Pitt, 906866; A/C1 G. J. Prior, 642074; Sgt. P. B. F. Pryke, 741959; A/C1 H. Reed, 630523; Sgt. W. H. L. Richards, 343318; Sgt. H. W. Sabin, 741765; A/C.1 E. J. Saunders, 702278; A/C.2 J. Sheasby, 948500; A/C.1 A. J. Smith, 743465; Sgt. C. A. R. Smith, 748498; A/C.2 B. Smith, 1356692; Cpl. R. W. Smith, 809010; Sgt. W. L. Smith, 900116; Cpl. H. D. Starck, 563787; Cpl. A. J. Stewart, 334962; A/C.2 P. Sutton, 942366; Act. F/O. E. E. Sweet, 44268; A/C.1 R. Tapner, 904596; L.A/C. L. W. F. Taylor, 538916; A/C.2 F. H. Turrell, 950387; L.A/C. R. P. Warner, 905251; A/C.2 W. F. G. West, 813222; P/O. W. B. Wheelwright, 41763; A/C.2 C. P. Williams, 117159; A/C.2 R. T. Yates, 919260; A/C.2 C. M. Yorke, 963688.

WOUNDED OR INJURED ON ACTIVE SERVICE.—A/C.2 M. S. Allcock, 1003471; Cpl. H. Anscombe, 752650; A/C.2 K. G. Apps, 1350340; A/C.1 W. H. Bentham, 938164; Cpl. G. S. Blakeley, 528328; L.A/C. D. Brownlie, 900228; L.A/C. E. J. Bunning, 753067; A/C.2 R. M. Carpenter, 552991; A/C.2 T. H. Clark, 1009085; A. Acce. B. G. Cook, 574539; A/C.2 T. C. Croxon, 1304443; L.A/C. V. Dale, 616618; A/C.2 E. B. Davies, 943445; Sgt. W. N. Davis, 918024; L.A/C. H. Donkin, 632880; A/C.2 H. S. Gillon, 912074; A/C.2 B. Henry, 1004605; A/C.2 P. W. Hobson, 975047; Cpl. W. Hullett, 507951; A/C.2 J. Jacobs, 915793; L.A/C. R. E. G. King, 801455; Cpl. D. L. Lee, 591044; F/O. J. R. H. Lewis, 39997; A/C.1 K. A. Lewis, 749031; Cpl. W. Lockerbie, 566994; L.A/C. J. B. McCracken, 612779; L.A/C. I. Macinnes, 909513; L.A/C. J. L. Matthews, 611277; L.A/C. E. J. Miller, 567648; Act. Wing Cdr. A. C. Mitchell, 27061; A/C.1 K. C. Myers, 914456; L.A/C. C. N. A. Nash, 546624; A/C.2 B. S. Nicholas, 1170323; A/C.1 S. Oakley, 650566; A/C.1 J. Orr, 951684; L.A/C. C. P. Panting, 541561; Sgt. D. E. P. Paul, 748790; A/C.1 H. Peters, 810119; A/C.1 J. Price, 905281; A/C.2 E. L. Procter, 1165045; A/C.2 H. F. Relt, 1011892; P/O. G. W. Salzgeber, 41325; A/C.1 R. G. Shorter, 756090; L.A/C. P. W. Spencer, 969332; L.A/C. G. Sturdy, 532954; L.A/C. R. J. Talbot, 645521; A/C.2 A. Topham, 937305; A/C.2 H. H. Valentine, 946540; L.A/C. L. W. T. Walker, 534758; A/C.2 F. A. Westmoreland, 1103753; Sgt. M. W. E. Wild, 937911; A/C.1 H. Wilson, 611607; A/C.2 E. Young, 952540.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. B. D. Clarkson, 42674; A/C.2 A. W. Collins, 1356479; A/C.2 J. Kennedy, 983513; A/C.2 G. H. Malivoire, 1255418; A/C.2 F. Sharrocks, 1003476; L.A/C. W. J. Tanner, 819076; L.A/C. S. Worral, 530243.

DIED ON ACTIVE SERVICE.—A/C.1 A. E. Canham, 770416; L.A/C. W. Y. Cann, 638518; A/C.2 R. C. Carlton, 975842; A/C.1 A. Edwards, 633370; Cpl. P. M. Long, 523539; Act. Cpl. D. W. Marwick, 966839; A/C.2 R. L. Milligan, 574767; Act. Wing Cdr. D. G. Motion, 79474; A/C.2 D. D. Philip, 1167635; L.A/C. A. G. Steel, 529407; A/C.1 J. S. Wiltshire, 633996.

PREVIOUSLY REPORTED MISSING, NOW REPORTED SAFE.—L.A/C. W. H. Silk, 528672.

PREVIOUSLY REPORTED "MISSING, BELIEVED KILLED IN ACTION," NOW REPORTED "PRISONER OF WAR."—L.A/C. O. A. Hutchinson, 524532; Sgt. C. H. Lowne, 580167; Sgt. C. J. S. Poole, 580415.

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "PRISONER OF WAR."—Sgt. R. Abel, 549202; Sgt. S. L. Bain, 742188; Cpl. G. A. Battve, 518'638; Sgt. A. E. Bowes, 521960; Sgt. G. F. Brixton, 511134; Sgt. F. J. C. Brown, 755817; Sgt. D. D. Cain, 542628; P/O G. K. R. Drimmie, 33472; F/O. P. F. Eames, 70196; Sgt. J. H. R. Edgar, 581149; Sgt. B. R. George, 967684; Sgt. J. Gilmour, 581093; Sgt. J. A. Kearey, 517684; Sgt. A. B. Langford, 581228; Sgt. R. W. Lonsdale, 755548; Sgt. K. Newton, 741543; P/O. J. W. P. Perkins, 42879; Sgt. E. H. Platts, 633813; Sgt. J. N. Prendergrast, 620735; Sgt. F. A. Saunders, 516998; Sgt. K. N. V. Townsend, D.F.M., 566584; P/O. H. S. P. Williams, 41974; L.A/C. J. Woods, 545046; Sgt. W. G. W. Younger, 567876.

OUR FASTEST FLYING BOAT: A Saro Lerwick being overhauled and serviced after a period of convoying, submarine spotting and other coastal reconnaissance duties. Our Service and civil flying boats are the envy of the world.

Royal New Zealand Air Force

KILLED ON ACTIVE SERVICE.—Sgt. D. O. Rewa, A.391869.

DIED ON ACTIVE SERVICE.—Sgt. J. S. Brennan, A.391875; Sgt. R. H. Clifford, A.391341.

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ROYAL AIR FORCE.

General Duties Branch.

Capt. F. C. Tracey, R.A.O.C., is granted a temporary commission as Flying Officer on being employed with the Royal Air Force, August 20.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Flight Sergeants: (Aug. 20, Sen. Aug. 14) G. B. Gillie; (Aug. 12, Sen. Aug. 7) E. W. J. Monk. Sergeants: (Aug. 1, Sen. July 30) H. R. Pooley; (Aug. 14, Sen. Aug. 7) J. H. V. Millinton; (Aug. 15, Sen. Aug. 9) A. E. Taylor; (Aug. 16, Sen. Aug. 8) C. K. Hayden; (Aug. 17, Sen. Aug. 8) R. E. Glover, F. P. Fry; (Aug. 18, Sen. Aug. 8) W. H. Norledge, G. F. Oliver; (Aug. 19, Sen. Aug. 8) D. Laing; (Aug. 19, Sen. Aug. 9) H. J. W. Bareham; (Aug. 20, Sen. Aug. 9) R. A. Recce; (Aug. 21, Sen. Aug. 9) J. R. Summers; (Aug. 25, Sen. Aug. 8) W. D. Evans; (Aug. 25, Sen. Aug. 19) A. V. Heaton, A. G. Smith.

P/O. on probation R. E. Lewis is confirmed in his appointment (April 3).

A.P/O. on probation A. N. R. L. Appleford is graded as Pilot Officer on probation (May 18).

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(April 16) C. B. Hull, D.F.C.; (May 19, Sen. May 19, 1939) E. R. E. Black; (July 6) P. E. Bennett; (July 13) J. G. Kerby; (July 21) D. Kain, J. E. J. Sing; (Aug. 6) J. N. Mahler, J. W. B. Richardson, F. E. Burton, D.F.C., D. Parker; (Aug. 17) P. F. Webster, D.F.C., D. L. England, D.F.C.; (Aug. 21), J. A. F. Mertens; (Aug. 25) J. T. Webster, C. J. F. Kydd, D.F.C., J. G. Sanders, D.F.C.; (Aug. 27) S. J. Monroe, H. L. Smeddle, D.F.C., C. D. Swain.

The undermentioned Pilot Officers are promoted to the rank of Flying Officer:—(Feb. 8, 1939) J. G. P. Greenwood; (April 26, 1939) J. H. T. Pickering; (Mar. 16, Sen. Jan. 30) S. N. T. Wallage; (April 27) J. A. H. Beckton; (June 17) R. M. MacKenzie, M. G. Homer, D.F.C., R. D. Clark; (June 29) R. A. D. Meharey; (July 3) R. E. Lewis; (July 17) A. Frame, G. C. B. Peters; (July 25) L. Williams; (Aug. 17) A. L. Rixalton, N. C. H. Robson, D. H. O'Neill; (Aug. 29) C. C. F. Cooper, E. C. Minchinton, E. Cassidy, D. B. Fitzpatrick, S. C. Norris, G. F. Morley-Mower, D. M. Woodman.

The undermentioned are transferred to the Technical Branch (April 24):—Group Captain: H. Gordon-Dean, A.F.C. (Ret.), J. H. Simpson, A. F. Lang, M.B.E., A.F.C., O. G. W.-G. Lywood, C.B.E. Wing Commanders: W. R. Day, V. G. A. Hatcher, A.F.C., E. M. Drummond, H. A. Evans-Evans, I. M. Rodney. Squadron Leaders: N. D. Gilbart-Smith, J. W. Rose, D.S.M., G.-L. S. Griffiths-Jones, M. K. D. Porter.

A.P/O. on probation M. S. Proudlock relinquishes his short service commission on appointment to a commission in the R.A.F.V.R. (Mar. 2).

The short service commission of P/O. on probation A. F. Fenton is terminated on cessation of duty (Aug. 25).

Errata.

In the *Gazette* of July 9, 1940. Notification concerning 562021 Sgt. Norman Sheldon Charles Chapman (43829). *For* Charles *read* Carlton.

The notification in the *Gazette* of Aug. 27, 1940, concerning P/O. Robert Scott (76470) should have appeared under the heading "R.A.F.V.R." instead of "R.A.F."

Technical Branch.

The undermentioned are granted commissions for the duration of hostilities as Flying Officers on probation:—Warrant Officers: (May 1, Sen. Feb. 15) D. G. Viney; (May 10, Sen. Feb. 15) G. W. Grayson; (May 20, Sen. March 14) T. J. Pritchard, E. L. Thompson; (June 5, Sen. March 14) C. T. Davies; (June 5, Sen. May 9) H. R. Ellis, A. A. Maton; (June 15, Sen. May 9) G. J. Symonds; (June 18, Sen. March 14) R. W. Moody; (June 20, Sen. May 9) B. J. Stevenson; (June 28, Sen. May 9) R. Pengelly; (July 4, Sen. March 14) H. S. H. Meech; (July 19, Sen. March 14) A. M. Casey.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Flight Sergeants: (June 20, Sen. May 16) E. J. Andrews; (June 24, Sen. May 30) C. E. Denning; (July 3, Sen. May 16) R. E. V. Hawker; (July 8, Sen. May 16) G. A. Symington; (July 19, Sen. May 16) H. R. Tucker; (Aug. 26, Sen. June 20) W. M. Simms. Sergeant: (June 14, Sen. May 16) G. S. W. Worsley.

SERVICE AVIATION (CONTINUED)

The undermentioned Flying Officers on probation are confirmed in their appointments:—(July 12) W. Bateson; (Aug. 16) G. A. V. Collins; (Aug. 21) E. G. Clarke.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant (sen. May 18):—(June 3) W. McCarthy, W. J. Scrivener; (July 1) M. F. G. Mill, D.F.M.; (July 7) W. R. Frost; (July 29) M. W. Moore, J. Woods.

Erratum.

In the *Gazette* of July 16, 1940. Notification concerning Sqn. Ldr. Thomas John Edward Thornton (13139). *For* John *read* James.

Balloon Branch.

The notification in the *Gazette* of Aug. 20 concerning P/O. A. J. Jones should have appeared under the heading "A.A.F." instead of "R.A.F."

Administrative and Special Duties Branch.

The undermentioned are granted commissions for the duration of hostilities in the ranks stated:—*Flying Officers on probation.* Warrant Officers: (May 9, Sen. March 7) E. S. McQuillan; (May 23, Sen. March 7) L. A. Dawson; (May 29, Sen. March 7) W. H. Franklin; (May 31, Sen. May 2) E. D. Deane, M.M.; (June 7, Sen. May 2) J. Benton. *Pilot Officer on probation.* Warrant Officer: (Aug. 6, Sen. July 22) R. O. Paisley. Flight Sergeants: (Aug. 16, Sen. July 25) N. R. Brian; (Aug. 21, Sen. Aug. 5) J. Willes.

F/O. A. E. L. Worster is promoted to the rank of Flight Lieutenant (July 29).

Equipment Branch.

The undermentioned are granted commissions for the duration of hostilities as Flying Officers on probation (seniority May 2). Warrant Officers: (June 18) A. J. Holliday, M.M.; (Aug. 22) A. W. Usher.

P/O. B. L. Howell is promoted to the rank of Flying Officer (July 17).

Accountant Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation. Warrant Officer: (Aug. 24, Sen. Aug. 7) E. H. Stamp. Acting Warrant Officer: (June 15, Sen. June 6) T. F. Frost. Flight Sergeant: (Aug. 24, Sen. Aug. 7) D. B. Flux. Sergeant: (Aug. 24, Sen. Aug. 7) W. R. E. Wilson. Leading Aircraftman: (Aug. 24, Sen. June 6) T. G. Galway.

The undermentioned Pilot Officers on probation are confirmed in their appointments June 10 and promoted to the rank of Flying Officer, July 31:—W. S. Smith, C. H. Sparks.

Medical Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(April 9) S. J. Welsh, M.B., B.Ch.; (Aug. 30, Sen. Aug. 30, 1939) J. L. Brown, M.D., Ch.B., M.R.C.S., L.R.C.P.

Dental Branch.

The undermentioned Flight Lieutenants are promoted to the rank of Squadron Leader (July 1): H. I. Clapperton, L.D.S., P. M. Margand, L.D.S.

F/O. J. N. Pimblett, L.D.S., is promoted to the rank of Flight Lieutenant (June 5).

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS.

General Duties Branch.

Flt. Lt. G. T. Dennys is granted the rank of Squadron Leader (Sept. 1).

F/O. E. A. Lane is granted the rank of Flight Lieutenant (Sept. 1).

P/O. H. L. Derwent is promoted to the rank of Flying Officer (July 17).

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The undermentioned relinquish their commissions in class CC on cessation of duty:—Flight Lieutenant: (June 30) E. P. Hardman, D.F.C. Flying Officer: (Dec. 10, 1939) D. Drummond-Hay.

Administrative and Special Duties Branch.

F/O. A. M. Diamant is transferred to the General Duties Branch (July 8).

P/O. S. S. Ganthony relinquishes his commission on account of ill-health (Sept. 5).

Dental Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(April 1) F. V. Frank, L.D.S.; (Sept. 4) J. W. Smith, L.D.S.

Royal Air Force Volunteer Reserve

General Duties Branch.

The undermentioned are granted commissions for the duration of hostilities as Flying Officers:—(Aug. 23) R. C. Cheshire, P. N. Colepeper, K. R. Collins, H. B. Fowler, W. S. Harding-Raynes, A. E. Hek, F. E. Knight, G. Littleton, H. J. Mann, S. Nelson, E. J. Travers.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Sergeants: (June 7, Sen. May 30) J. P. Jamieson. W. O. Weaber; (June 19, Sen. May 2) H. D. Rankin; (June 29) J. H. Baldry; (July 13, Sen. July 11) B. G. Glover; (July 20, Sen. July 11) G. T. Langley, A. J. Brooks; (July 27, Sen. July 21) K. J. Marston, E. Plumtree; (July 27) N. D. Gough, D. M. Vine, (Aug. 5) G. North; (Aug. 10, Sen. July 30) H. Cast; (Aug. 10) J. D. Davies, R. J. Fuller, G. D. Green; (Aug 10, Sen. Aug. 4) T. A. Watson, P. B. Hodgson, (Aug. 13, Sen. Aug. 7) W. J. Hunt; (Aug. 17, Sen. Aug. 7) C. R. Brown; (Aug. 17, Sen. Aug. 14) E. A. Sawyer; (Aug. 17) P. M. Andrews, J. K. Kay, J. R. Waterman, R. W. J. Tarrant, E. W. Tate, T. R. Ruxton, S. B. Wills; (Aug. 20, Sen. Aug. 9) G. A. Becker. Corporal: (July 15, Sen. May 9) R. G. Guest. Acting Corporal: (Aug. 11) M. J. Higgins. Leading Aircraftmen: (July 28) V. S. Padgham; (Aug. 11) R. H. F. Bandy, R. S. Lawrence.

M. S. Proudlock is granted a commission for the duration of hostilities as Acting Pilot Officer on probation (March 2).

Pilot Officer on probation J. G. Forbes is confirmed in his appointment (March 29).

Acting Pilot Officer on probation M. S. Proudlock is graded as Pilot Officer on probation (July 13).

The undermentioned Pilot Officers are promoted to the rank of Flying Officer:—(Sept. 23, 1939) P. B. Newson-Davis; (July 10) M. S. Burbery, C. T. Oakes; (July 31) L. W. Coleman, L. L. Pyman, G. P. Yarrow.

Acting Pilot Officer on probation R. J. J. Welcomme is transferred to the Administrative and Special Duties Branch and graded as Pilot Officer on probation (Aug. 17).

Flt. Lt. C. F. Trench relinquishes his honorary commission on cessation of duty (Feb. 4).

The commissions of the undermentioned Acting Pilot Officers on probation are terminated on cessation of duty:—(July 7) C. C. Pomeroy; (Aug. 9) A. S. Colliason.

F/O. J. Peel is cashiered by sentence of General Court-Martial (Aug. 28).

The notification in the *Gazette* of Aug. 20 concerning J. J. Stevens is cancelled.

The notifications in the *Gazette* of July 30 concerning A. G. Donahue and V. W. Olson are cancelled.

Technical Branch.

Flt. Sgt. C. F. Stephens is granted a commission for the duration of hostilities as Pilot Officer on probation (July 29, Sen. May 30).

Balloon Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Sergeant: (Aug. 1, Sen. July 18) G. M. Miller. Corporal: (Aug. 18, Sen. Aug. 8) W. H. J. Wilkie; (Aug. 19, Sen. Aug. 12) L. T. Fayers; (Aug. 23, Sen. Aug. 12) M. H. Kinsman. Leading Aircraftmen: (Aug. 13, Sen. Aug. 8) G. V. Harding; (Aug. 24, Sen. Aug. 6) E. Rankin.

Administrative and Special Duties Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—(May 4) A. G. Dunton; (May 25) P. L. Hogan; (May 31) F. J. Walter; (June 17) L. F. A. Green; (June 25) F. H. A. Thodas; (June 26) D. J. Sheridan; (June 27) P. E. Bourne, H. A. Brett, R. B. Elliott, H. A. Hyde, J. Perrin, F. W. Wright; (June 28) K. S. Douglas, E. V. Whittle, H. T. Worlock, O. Hughes; (June 29) W. F. R. Boardman, I. F. H. Jones, D. L. Pritchard; (July 1) H. S. Cardew, H. R. Collins, W. T. Kennedy, J. J. Mumford, Sir G. E. Stott, Bt., E. Thursfield, C. Wade, G. E. Walker, R. S. P. Wells, M.C., J. Williamson, D.C.M., M.M.; (July 2) V. D. Bercot, T. Doyle, G. W. Tucker; (July 3) E. Green, E. Walker, J. Warham; (July 4) G. P. Daniels; (July 5) G. E. Bond, A. E. Wright; (July 6) R. J. Reese, J. S. Smith, C. E. White; (July 8) E. C. Griffin, S. Smith, G. V. Williams, M. A. Bentley, F. L. Megson; (July 10) H. S. Turner, W. P. T. Vear; (July 12) R. A. Greaves, C. de V. Harding, (July 13) R. I. H. Isdell-Carpenter, J. E. W. Wheatley; (July 14) I. G. A. Faulk; (July 15) G. E. J. Gilbert-Green; (July 16) W. H. Lowe, D. S. Crawford, G. E. Lewis; (July 17) R. W. Fraser, H. E. Blake, J. Roberts, C. W. Sargison, A. G. Turnell, W. J. Witham; (July 18) D. K. T. Truscott, R. E. Sanson; (July 19) R. A. Ratcliffe; (July 24) H. H. G. Boal, C. Price; (July 26) C. Brinkman, J. H. Lewson, H. T. Molloy, D.S.O., B. W. Noble, E. B. Slade, A. E. G. Steele; (July 29) A. J. Brown, P. J. A. Calvocoressi, C. N. Croysdale, B. E. De La Torre, G. A. Hoffen, R. M. Kirkpatrick, J. Lord, G. M. F. Stow, J. N. T. Watson, A. F. Wills, E. S. B. H. Wollmer, H. R. Chart, J. G. Collis, V. B. Dowling; (July 30) W. S. Tinsley; (July 31) L. Fothergill; (August 1) P. S. Silley; (August 4) A. M. Carrie; (August 5) W. D. Phillips, A. B. W. Thomas; (August 6) A. V. Bateman; (August 9) A. G. Alsop, E. W. Anderson, K. H. Bain, W. T. Baker, E. V. B. Bartlett, A. W. Berry, A. W. Bodfield, J. M. Bowie, W. P. Bowles, R. D. Boyd, W. G. Bradshaw, R. R. A. Bratt, D. L. Breeden, E. F. Brooks, W. Brown, H. J. Budd, J. L. Burgess, J. R. Chamberlain, L. I. Cockerham, S. V. Colbran, D. Craik, D.F.C., A. E. Cure, G. Dixon, R. Dobson, S. G. Driver, T. U. Dunn, J. C. Edwards, E. H. G. Evans, M. Finkell, M. I. Forsyth-Grant, K. M. Freeman, W. D. Furniss, A. W. Geddes, C. C. Glover, R. A. Green, V. Hall, A. W. Harrison, S. P. J. Hill, N. R. G. Hunter, G. B. Johnson, W. T. Jones, L. A. R. Kemp, L. L. Kenchington, A. F. Kind, F. S. Lamping, J. Leigh, D. R. B. Mackenzie, J. P. May, L. F. Miller, E. W. Moeran, I. W. Richards, N. Roberts, K. D. U. Rogers, J. H. Rowse, Jun., L. Rowson, A. Smith, R. A. C. Sumner, D. N. Twist, E. Urlwin-Smith, L. F. P. Walters, C. R. Watson, E. G. K. Weakley, D.F.C., G. B. Weston, E. Whitehead, J. L. Williams, F. B. Wilson, J. E. Yeo; (August 10) V. A. Jackson, G. V. Learmond; (August 13) C. A. Moffatt; (August 14) A. R. Carirae, W. P. Gill, H. G. Matheson; (August 15) W. H. Allen, R. E. Borneman, P. M. Fowler, R. M. Page, E. J. Swift; (August 16) G. A. Mortis, J. W. Wright; (August 17) N. F. Harris, J. A. Kemsley, C. D. Mac Williams, J. A. P. Martin, D. A. Parrott, H. Paston-Williams; (August 18) E. S. Dawkins, R. A. Henderson; (August 19) S. E. Arridge, J. W. Brown, E. W. Coveney, E. T. Dangerfield, Sir C. A. de Bathe, Bt., E. Fowler, H. S. Hicks, A. C. M. Jackaman, O. G. L. P. Powell, R. S. Randolph, R. G. Stafford, R. M. Sterndale; (August 20) C. S. Fleet, A. T. Hardy, L. E. Saxby; (August 21) A. W. Clarke-Edwards, T. A. Cunliffe, F. H. Dean, D. F. Dunstan, T. S. G. Hunter. Sergeant: (August 26, Sen. July 25) M. W. Cruse.

The undermentioned Flight Lieutenants are promoted to the rank of Squadron Leader:—(September 6, 1939) J. W. C. Glen; (September 9, 1939) W. H. E. Tew; (September 19, 1939) L. T. Kerry, M.C.

Pilot Officer on probation P. G. Richardson is transferred to the Technical Branch (June 24).

The commissions of the undermentioned Pilot Officers on probation are terminated on cessation of duty:—(August 15) D. Sheridan; (August 22) T. F. Ball; (August 23) H. W. Owen.

The undermentioned relinquish their commissions on account of ill-health:—Flying Officer: (September 7) C. McEvoy. Pilot Officers on probation: (September 5) J. W. Jones; (September 4) F. H. Rob; (September 9) T. A. Moffet.

The undermentioned Pilot Officers on probation resign their commissions:—(July 31) J. F. F. Platts-Mills; (August 29) E. K. Stephenson.

Equipment Branch.

The undermentioned are granted commissions for the duration of hostilities as Pilot Officers on probation:—Sergeant: (August 19, Sen. August 6) W. G. Phillips. Corporal: (August 17, Sen. July 30) W. G. Clegg.

The undermentioned Pilot Officers are promoted to the rank of Flying Officer:—(September 5) F. J. Sharp, J. S. Henchman.

Medical Branch.

The undermentioned are granted commissions for the duration of hostilities in the ranks stated:—Flight Lieutenant: (August 13) H. L. Catchlove, M.B., B.S., M.R.C.S., L.R.C.P. Flying Officers: (August 20) G. C. Barron, M.B., B.Chir., M.R.C.S., L.R.C.P.; J. C. Bryce, M.R.C.S., L.R.C.P.; R. G. Griffiths, M.R.C.S., L.R.C.P.; C. S. Grossmark, M.B., B.S., M.R.C.S., L.R.C.P.; H. T. Hardy, M.B., Ch.B., L.R.C.P. & S.; S. W. Hinds, M.R.C.S., L.R.C.P.; B. Roditi, M.B., Ch.B., M.R.C.S., L.R.C.P., D.C.H.; J. E. Smith, M.B., Ch.B.; W. A. Steel, M.R.C.S., L.R.C.P.; G. A. van Someren, M.R.C.S., L.R.C.P.; J. H. D. Wetherell, M.B., Ch.B.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(July 18) W. K. Stewart, M.B., Ch.B.; (July 25) T. C. Henry, M.R.C.S., L.R.C.P.; W. L. Hector, M.B., Ch.B.; (August 1) L. S. Calvert, M.R.C.S., L.R.C.P.

Dental Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(July 18) H. W. Walker-Smith, L.D.S.; W. R. Gray, L.D.S.; (July 25) C. Parmée, L.D.S.; (August 29) J. Liddiard, L.D.S.; F. L. Hossell, L.D.S.

Chaplains Branch.

The undermentioned are granted commissions for the duration of hostilities with the relative rank of Squadron Leader:—(August 23) The Rev. V. R. H. Vivian; (August 26) The Rev. R. T. G. Pearson.

Auxiliary Air Force

Accountant Branch.

P/O. H. J. Cuff is promoted to the rank of Flying Officer (August 15).

Medical Branch.

The undermentioned Flying Officers are promoted to the rank of Flight Lieutenant:—(August 25) J. Cann, M.B., B.Chir., M.R.C.S., L.R.C.P.; (August 26) G. H. Duthie, M.B., Ch.B.; (August 29) E. C. Davis, M.R.C.S., L.R.C.P.; H. J. Harcourt, L.M.S.S.A.

Women's Auxiliary Air Force

The undermentioned are appointed Assistant Section Officers:—(August 31) A/CW.1 Miss H. F. E. Allison, Cpl. Miss V. S. Alpine, A/CW.2 Miss J. A. Bouquet, Cpl. Miss M. H. Brash-Grant, Sgt. Miss J. I. Brown, Sgt. Miss M. H. Brown, A/CW.1 Miss M. M. Burns, A/CW.2 Miss J. G. Carew-Fisher, A/CW.1 Miss M. Crawford-Smith, Sen. Sgt. Miss D. A. Fowle, Cpl. Miss A. C. Francis, A/CW.2 Miss J. R. Grainger, A/CW.2 Miss M. E. House, Cpl. Miss L. M. Jackson, A/CW.1 Miss V. M. Jenkins, A/CW.1 Miss B. R. Killick, Sgt. Miss M. A. McG. King, A/CW.1 Miss A. C. Love, Sgt. Miss M. F. Newman, A/CW.2 Miss E. A. Nugent, Sgt. Miss R. Oliver, Sgt. Miss H. B. B. Prowse, A/CW.2 Miss D. B. Richardson, A/CW.2 Miss J. M. Shaw, A/CW.1 Miss F. J. Shoobridge, Cpl. Miss J. W. Silvester, A/CW.1 Miss J. E. L. Staden, A/CW.1 Miss D. C. M. Stott, A/CW.1 Miss E. M. Tanner, Sgt. Miss E. M. Thompson, A/CW.1 Miss N. R. van Gelder, Cpl. Miss J. B. Walker, A/CW.2 Mrs. R. C. Williams.

The undermentioned Assistant Section Officers relinquish their appointments:—(August 29) Miss E. S. Winton; (September 9) Mrs. P. F. Johnson.

THE INDUSTRY

Workers' £1,000 for Forces

THE workers at Fort Dunlop have taken £1,000 from the reserves of their Hospital Benevolent Fund and bought with it an ambulance and an up-to-date mobile canteen, completely equipped, for the use of the Forces. The canteen will be staffed and run by the Y.M.C.A., which looks after the Midlands.

Welding Dissimilar Metals

BARIMAR, LTD., announces a process for welding together non-ferrous and ferrous metals which depends for its success on a new flux, special methods of manipulation and accurate flame control. The strength of the weld is claimed to be not less than that of the weaker metal.

Anti-vibration Mountings

IN order to help engineers eliminate vibration in such places where standard mountings are unsuitable, Silentbloc, Ltd., have issued a booklet describing some alternatives which may be used where dimensional or other restrictions arise. The range described in the booklet is not intended to show all the types of special mountings which Silentbloc have produced, but rather to be an indication of the many arrangements available.

Design departments should apply to Silentbloc Ltd., Victoria Gardens, Ladbroke Road, Notting Hill Gate, London, W.11, for a copy.

Refrigeration for Testing Cables

WEATHERPROOF overall compounds and finishes of cables may frequently be subjected to wide variations of temperature in use.

In recent years there has also been an extended use of insulated cable in commercial and service types of aircraft. This has intensified the problem of developing lacquered cables to operate efficiently over a temperature range of the order of minus 10 deg. F. to plus 120 deg. F. which exist in the more exposed parts of aircraft. The conditions in these situations also involve intense vibration and subjection to the deleterious effect of moisture, oils and petrol.

Air Ministry specifications incorporate tests involving the effect of cooling on the flexibility of cables both with and without the overall braiding and lacquer. The procedure involves the placing of the sample length in a low-temperature atmosphere for a definite period and conducting a bending test round a mandrel at the same temperature level. It is possible that future specifications for aircraft cables may also incorporate fatigue tests on metallic conductors when subjected to low temperatures as well as the effect of vibration on cables when installed in conduit. If in the future conductors of metals other than copper are considered from the aspect of the saving of weight, such tests would be of considerable significance.

The General Electric Co., Ltd., subsidiary, Coldair, Ltd , have developed refrigeration equipment for this purpose during the past few months, and units have been supplied to several manufacturers.

In front of the refrigerating unit there is a control panel on which is mounted a large recording thermometer and two thermostatic controls with ranges from minus 20 deg. F. to plus 10 deg. F. and 15 deg. F. to 45 deg. F. respectively. A rotary switch for changing over to the thermostatic control with the range desired is also included together with a defrosting switch to operate the small air circulating fan fitted inside the cabinet for defrosting.

The procedure is to place the cable in the refrigerator cabinet, where it is left for periods of 3 to 21 days, depending on type of cable and purpose for which it is intended. A small door in the main access door to the cabinet, is fitted over an open observation aperture through which samples can be withdrawn as required during or after experiments.

Oilite Size List

IN their latest publication The Manganese Bronze and Brass Co., Ltd., give detailed dimensions, in inches and millimetres, of all the available sizes, and lengths of Oilite self-lubricating bronze bearings. Many new sizes are included in this edition. In addition to the range of sizes, formulæ is given for calculating correct bearing dimensions, and further chapters deal with assembly, loads and speeds, machining and supplementary lubrication. Copies are to be had from The Manganese Bronze and Brass Co., Ltd., Caxton House, London, S.W.1.

New Aircraft Materials

THE Northern Aluminium Company are obtaining a 0.1 per cent. proof stress of over 20 tons/sq. in. with one of their copper-containing aluminium alloys when used as a gravity die casting. Known as NA226, it will give a proof stress of 24 tons/sq. in. when chill cast, with an ultimate tensile strength of 27 tons/sq. in. and an elongation of 5 per cent. With different heat treatment this can be raised to 15 per cent.

Resinoid tubing is another new material. Made of polyvinyl alcohol, the tubing has a high resistance to fats and organic solvents and is claimed to be impervious to oils and petrols. Among its other desirable properties are low specific gravity, high abrasion resistance and resistance to flexing and vibration. The material is also made in sheets and rods.

Trade Catalogues

THE Central Public Library of Wellington, New Zealand, has established a collection of trade catalogues in order to serve the interest of both buyers and sellers of goods. The collection is accessible to the public, and the Library is most desirous of adding to it. Any firms who wish to send their catalogues should address them to The City Librarian, Central Library, P.O. Box 1529, Wellington C1, New Zealand, and their receipt will be acknowledged. Packets should be marked "Printed Matter Only" and forwarded as second class mail.

Alkaline Batteries

USED for many specialised purposes in peacetime, there are, of course, many reasons why this type of battery is used so extensively in the nation's war effort. Briefly, they may be summed up as follows. First, they are made of steel; they are robust in construction, and will survive any amount of rough usage. Secondly, owing to the electrical characteristics of alkaline batteries, they are capable of standing idle for long periods without serious loss of charge, and without any material or electrical damage; and, lastly, because of the two reasons stated, they have exceptionally long life in service, are practically trouble-free, and therefore have low maintenace costs. it is also interesting to note that these batteries can be boosted at such high rates as twice the normal charging current for any period from 30 to 60 minutes, provided the battery is in a discharged condition.

Such batteries, made by Messrs. Britannia Batteries, Ltd., in their modern works at Redditch, Wores, ranging in capacity from 5 to 500 ampere-hours, are the result of many years of research and manufacturing experience.

AERONAUTICAL PATENT SPECIFICATIONS

(Published July 4, 1940.)

1938.

34515. PORSCHE, F. Manufacture of vehicle and aircraft bodies (521,900).

34579. SPERRY GYROSCOPE CO., INC. Gyroscopes (521,913).

34604. TAMPIER, R. Means for operating control surfaces of aircraft (521,019).

35381. WOCHER, M., FLUCK, F., and NIEDERMANN, J. Aerostat, particularly for air-defence purposes (522,111).

35527. STANDARD TELEPHONES & CABLES, LTD., and BRAENDLE, E. W. Automatic direction-finders (522,129).

1939.

141. UNITED AIRCRAFT CORPORATION. Screw-propeller blade (522,064).

(Published July 11, 1940.)

1938.

32243. ALGARSSON, G. Variable-pitch propellers (522,249).

35207. BRISTOL AEROPLANE CO., LTD., and GADD, E. R. Manufacture of austenitic ferrous-alloy articles (522,252).

35309. MERCIER, J. Hydraulic accumulators adapted for use on aircraft (522,261).

35330. BOULTON PAUL AIRCRAFT, LTD., and NORTH, J. D. Safety device for aeroplanes (522,266).

35677. SPERRY GYROSCOPE CO., INC. Magnetic compasses (522,184).

1939.

7794. UNITED AIRCRAFT CORPORATION. Liquid-cooled engine cylinders (522,346).

(Published July 18, 1940.)

1938.

21764. GOLDSCHMIDT, R. Stabilising flexible cables, particularly for use in aerial warfare (522,626).

32088. NAPIER & SON, LTD., D., HALFORD, F. B., and VICKERS, C. F. Flexible supports (522,415).

32948. BRISTOL AEROPLANE CO., LTD., GADD, E. R. and KEATES, H. Manufacture of nitrided steel articles (522,475).

35825. SPERRY PRODUCTS, INC. Slow-period indicating-float elements for indicating-instruments (522,435).

36077. DODSON, E. Means for controlling aircraft engines (522,592).

36148. OLAER PATENT CO., Propellers with variable pitch (522,604).

(Published July 25, 1940.)

1938.

26190. CROUCH, R. J. G. Aeroplanes (522,777).

31783. HELLMUTH, J. A. Apparatus for lighting areas particularly applicable to facilitating night landings by aircraft (522,778).

32576. DOWTY, G. H. Aircraft undercarriages with resilient wheel mountings (522,830).